

An Account of Coronavirus and COVID-19 Prevention

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Abstract

With the declaration of pandemic by world health organization (WHO), coronavirus disease 2019 (COVID-19) has become a major cause of concern for the doctors, researchers and scientists globally. The governments and general population of various countries have been overwhelmed by the highly contagious nature of the disease, which has till date infected more than 5 million people worldwide. Since the disease is new, information about the virus and its pathogenesis is scarce. Further, there is no clear preventive and therapeutic regimen available and thus countries have resorted to lockdown and social distancing and forced the humanity to stay inside homes to control the contagion. The information about the virus and how to contain the spread is limited and prevention is limited to avoidance. Herein, an account of the virus and the disease caused by it, have been presented in simplified manner to help general people grasp the information and utilize to stay safe and healthy.

Keywords: *Corona Virus; SARS-CoV-2; Coronavirus Disease 2019; Pandemic; COVID19; Contagion*

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a new virus as named by the International Committee on Taxonomy of Viruses (ICTV) in February 2020 based upon its genetic similarity with the coronavirus that was responsible for the SARS outbreak of 2003 [1]. Further, the disease caused by the infection of SARS-CoV-2 was named as coronavirus disease 2019 (COVID-19) by WHO in the International Classification of Diseases according to the guidelines of the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) [1]. COVID-19 was recognized as a new threat to the human health and was elevated to pandemic status by the world health organization (WHO) on 12 March 2020 as it spread out of China to the European countries [2]. Since then the cases have spread to more than 215 countries and nearly 5 million people have been affected by this disease and more than 315,000 people have succumb to this outbreak and died [3]. According to medical bulletins and reports, the severe and fatal COVID-19 cases involve a majority of those patients who are obese or having related comorbidities such as cardiovascular complications, diabetes and hypertension. The centers for disease control and prevention (CDC) suggested that obesity with a body mass index (BMI) of 40 or above puts people at higher risk for complications from COVID-19 [4].

Here an account of Coronavirus has been presented in the form of question answer format for enhancing general understanding about the virus itself and the ways of its spread, infection and prevention strategies.

How does the Coronavirus look?

The size of the novel coronavirus is between 80 to 120 nm in diameter. It is not visible by naked eye, not even by light microscope. It is so tiny that you need a special electron microscope to visually look at it. Being so tiny it can remain afloat in air for longer period of time in the form of droplets or aerosols and therefore highly likely to infect unsuspecting individuals.

The structure of the virus can be understood as a very tiny sphere made up of lipid containing a genetic material RNA inside it. Usually the genetic material in other organisms is DNA but many viruses have RNA in place of DNA (Figure 1). In addition, the virus has a protein called spike protein on the surface which helps the virus dock and enter in the human nasal and lung epithelial cells leading to infection.

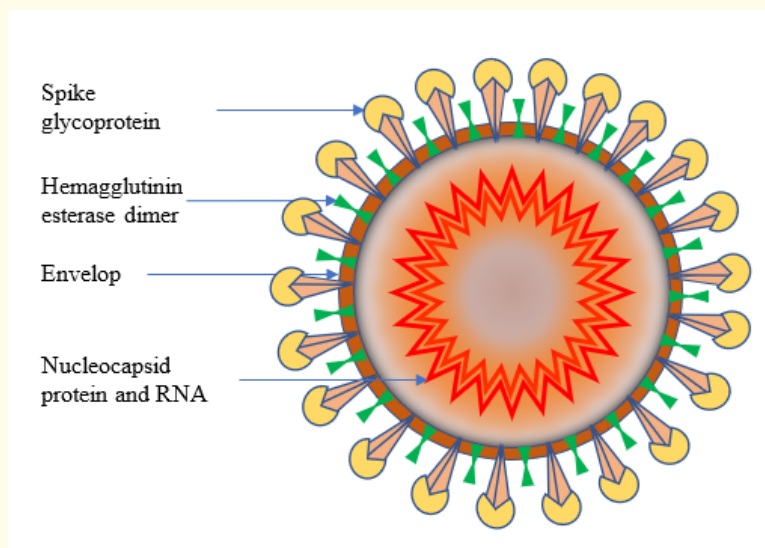


Figure 1: Sketch of SARS-CoV-2 virus.

Being in the form of it droplet, this virus is degradable by anything that can destroy the lipids, for example detergent, which clears it by saponification and therefore can destroy it. Other disinfectant like bleach or hypochlorites can also destroy it by oxidizing the lipid layer covering.

How coronavirus infects humans?

Once released by an infected person in the air while talking loudly, sneezing, coughing or yawning, the virus floats in the air in the form of aerosols and if any unsuspecting person comes in close proximity it is likely that some droplets could reach to his nostrils or mouth and through these routes they will attach to the cells in the mucosal linings of nose/mouth. Additionally, some of the heavy floating droplets released by infected person could settle on surfaces like handles, railings, keys, notes, packets, elevators keys, and many other surfaces. When next person, who does not know whether an infected person may have coughed there earlier and droplets might have deposited on the surfaces, touches those surfaces, the virus could stick and reach to him.

Other than this, lately it has been found that virus in small droplets can remain suspended for longer period of time in the uncirculated air like in an elevator or a closed and unventilated room. So, even if you do not touch a surface, you may likely get it by just breathing in those places if not masked properly. Thus, best way to protect and prevent from getting infected by the virus is to stay home, wash hands regularly with soap/detergent, and wear mask. Accordingly, the governments have imposed lockdown and forced people to stay home. Lately, the realization that lockdown cannot be a sustainable strategy and it can cause more damage to people in terms of economic disruption, job losses, hunger and psychological consequences the lockdown is being eased and people are being told to live with the virus by adopting physical distancing, wearing masks and sanitize the hands regularly.

Now coming to infection part, when virus enters through mouth or nose, it sticks itself to the epithelial cells through its docking protein, spike glycoprotein. The cells have a receptor for this protein, which acts like a door lock, and the viral protein acts like a key, which enters the lock and opens it and allows the viral genetic material RNA to enter the cell.

The virus is a nonliving particle as long as it is out of any living cell. As soon as it enters a live cell, it hijacks the cellular machinery of host cell to make more copies of its genetic material which are packaged in new lipid coat derived from the host cells. In a short span of time millions of viral particles are made and are released by lysing or killing the host cell. Next, these newly released virus particles infect neighboring cells and in which they travel to lungs and other body parts causing the excessive damage to the organs and disrupting their normal physiology and cause COVID-19 disease.

How does coronavirus cause disease in infected person?

In healthy persons, the terminal branches of bronchioles open in the small vesicles or sac like structure called alveoli, which have two types of cells. Type I alveolar cells help in oxygen and carbon dioxide exchange between the blood and thin layer of lung epithelial cells. Type II cells release surfactant, which is a foam like substance that keeps the lungs inflated and in its absence, lungs would collapse like deflated football bladder.

Once the coronavirus reaches lungs, they primarily infect the type II cells which produce surfactant. Once inside, the virus makes millions of copies of itself, that destroy the host cells and infect the nearby cells. This is the infection stage when virus number increases exponentially.

By this time, or earlier also, the immune cells would have recognized the threat and rush to the infection site. Once there, they release inflammatory signals to alert the other immune cells of impending danger and to kill the infected cells so that the virus does not spread to other cells. But in this effort, they also kill the healthy cells, a kind of collateral damage. Due to this and some inflammatory molecules secreted by immune cells the fluid gets deposited in the lungs leading to breathing difficulty. Since the surfactant secreting cells are also low, the lung starts collapsing. This is the moderate infection stage. The battle between immune cells and virus goes on continuously. If the battle is won by the immune cells, the situation improves and slowly the person recovers. The deposited fluid clears, virus infected cells are cleared by macrophages, and new alveolar cells regenerate slowly, and person recovers.

However, if the battle is won by the virus, the excessive loss of type II alveolar cells results in collapse of lungs due to shortage of surfactant. The fluid is filled in the lungs and loss of type I cells lead to little or no oxygen exchange, resulting in low oxygen level in blood. This becomes severe acute respiratory syndrome or SARS on which account this virus has been named. If the patient is not treated at this time, or treated but does not respond to the treatment, he succumbs to complications which include septic shock and multi-organ failure. It has been found that more than 95% of mortalities caused by COVID-19 in Europe was of people who were of 60 years age or older [5]. The older people of age 60 - 65 or more have relatively weaker immune system and which could be the reason for increased fatality, which further increases if they have other comorbid conditions such as cardiovascular and pulmonary illnesses. Similarly, the obese people also

have compromised immune system due to persistent low-grade inflammation and are more prone to develop severity upon corona virus infection [6].

What are the likely treatments for COVID19?

In case of initial infection, if person has good immune response the inflammation remains low key, in check and resolves slowly. This usually is the case when the patients are young, active and physically fit. The symptomatic relief can be achieved using anti-inflammatory and analgesic treatments under the observation of a doctor. In the mild or moderate conditions, serious symptoms may develop including fluid in lungs, fever, difficulty in breathing, cough etc. but slowly with treatment regimen the situation improves, the lung fluid gets cleared, and the infected cells also get cleared by the immune cells.

However, in patients with compromised immune system and comorbid illnesses, like in patients of older age, obesity or with cardio-pulmonary comorbidities, situation aggravates quickly and become irreversible. In such scenario, the patients are sent to intensive care unit (ICU) and are given respiratory support through ventilator and a multi-pronged therapeutic regimen is administered to save the patients.

If patients respond well to the administered medicines and life support system, they get back to normalcy slowly, but if they do not respond, they succumb to complications which include septic shock and multi-organ failure.

Who should get tested for COVID-19?

Ideally, all should be tested. But many countries that have huge population like India with 1.3 billion plus people, or those who cannot afford it, may not test all its population and resort to testing based on symptoms.

So, initially they focused only on screening those who returned from abroad and/or had travel history. After screening, if they were found with symptoms they were tested (screening means measuring the body temperature, which was done by infrared thermometer from a distance). In next step, people who had symptoms and/or contact/travel history were tested. But because incubation period of the virus is variable and took up to 14 days, initial testing gave low positive cases.

Since COVID19 is a new ailment with no known history, the understanding is evolving with time as the spectrum of symptoms being revealed by diverse patients' population and also time being taken by them in showing the symptoms. Recently, some experts have recommended 28 days of quarantine time realizing that some asymptomatic patients could harbor the virus for more than 2 weeks before they either get rid of the virus themselves (of course due to their adequate immune response against the infection) or develop some sort of symptoms to be identified as infected and get tested and treated [7]. Further, as the capacity builds up in many countries, the number of testing could increase with time

Dose this virus exists on surface where positive cases are found?

The virus does exist in the area and spaces where the patients live including their houses, hospitals, and public spaces where they knowingly or unknowingly visit. The virus remains infectable for different durations from few hours to a few days depending upon the type of surface they have landed after coughing or sneezing [8]. In fact, they also remain suspended in the air for quite a long time and could spread through air in an enclosed area with no or little cross ventilation. So, in a closed space like elevator or a room, if the infected person has been there, it is likely that virus may be lingering the air and can infect others using that space and not masked properly. Many community spread cases with no travel history or direct contact have been found due to this nature of the corona virus. Thus, wearing good quality mask in public spaces whether crowded or not, avoiding touching surfaces, washing hands regularly and avoiding touching mouth, nose and eye are the ways one can protect effectively from Coronavirus.

Conclusion

The humanity has faced an unprecedented challenge in the form of novel Coronavirus spread and resultant COVID-19 pandemic. The governments have resorted to the lockdown to prevent the spread of virus but that cannot continue endlessly. People have already started resisting the lockdown in many countries as it has affected their livelihood, jobs, and normal routine. Although the development of effective vaccines and therapeutic drugs will take some time, the hygiene practices and greater understanding of how virus infects and cause the disease and how it can be contained from spreading among general population can save millions of lives.

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