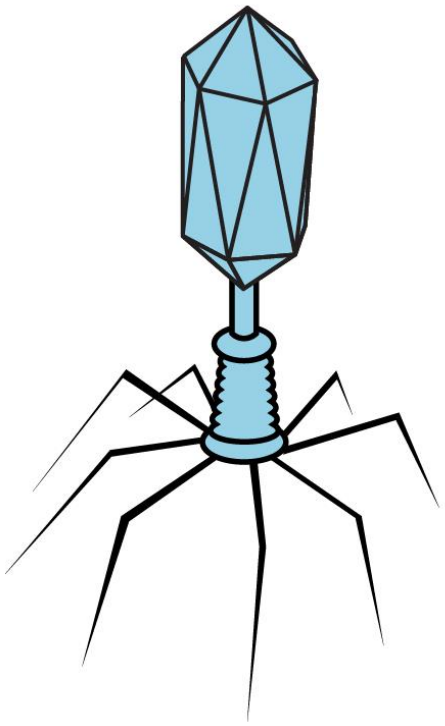

CORONA VIRUS: ANALYSING THE PANDEMIC

Armaan Gupta
2021

Contents

Abstract

The Novel Corona virus had initiated a global pandemic more than a year ago. Research and scientific development in virology and on corona virus continues to unveil valuable information that helps in curing infections and develop better vaccines. On the other hand, a lot of panic and confusion amongst global citizens is created due to the wide-spread of fake news that is not scientifically backed.

Corona virus disease is a viral infection of the SARS corona family. Its symptoms range drastically. While corona virus mainly affects the respiratory system, it can also have adverse side effects on other systems in case of pre-covid diseases (especially in the elderly).

The transmission of corona virus is through mainly 3 ways. The first and second are quite similar where they are transmitted through droplets containing the virus. The third is trough formites or contact with infected surfaces.

Corona virus can be prevented by simply wearing a fresh mask every day and sanitization of hands and nearby surfaces.

This paper aims to cover the major aspects of this new disease with scientifically proved data.

About SARS-CoV-2

Coronavirus generally occurs in animals and birds. During this pandemic, the coronavirus disease has also caused infection in humans via the SARS-CoV-2 virus. As the name suggests it originates from the SARS corona family. SARS stands for severe acute respiratory syndrome.

Corona virus gets its name from it shape or the crown shaped protein receptors found on its viral membrane/envelope.

The SARS-CoV-2 virus mainly attacks the respiratory system causing mucus to form in the alveoli making it difficult to breath (more in the immune response and effect section). A lot of symptoms are seen, although fever, cough and breathlessness are the most common.

Structure and Genetics

Structure of General Viruses

The structure of viruses depend on its genome. All viruses are extremely primitive with almost no biomechanical or biochemical systems to help it carry out life processes. This is also the reason viruses are considered both living and non-living.

Typically viruses have their main genetic information encoded in minimal strands of DNA or RNA. The nucleic acid is

covered/enclosed in a protein based structure called a capsid. This protective protein coat can vary in shape and size depending on the type of virus. The smaller protein unit that makes the capsid is called the capsomer. Capsid and Genome combined make the nucleocapsid.

Some viruses also possess an extra envelope layer. This layer (unlike the capsid layer) is not made by the virus itself. A virus can only get it from an infected eukaryotic or prokaryotic host cell. In some cases where this phospholipid layer also contains cell receptors, it gives the virus some advantages (especially if interacting with other cells in a host's body), such as, access to the body's defence mechanisms, ability to hide from the immune system, communication with other cells, access to biochemical systems, access to biomechanical systems, etc.

Most viruses also have spikes like structure on their envelope (if envelope is absent then these spikes are present on the capsid). The top of the spike contain knob like proteins that are like locks which can disable the virus. If the perfect antibody touches the Envelope protein, the virus is disarmed.

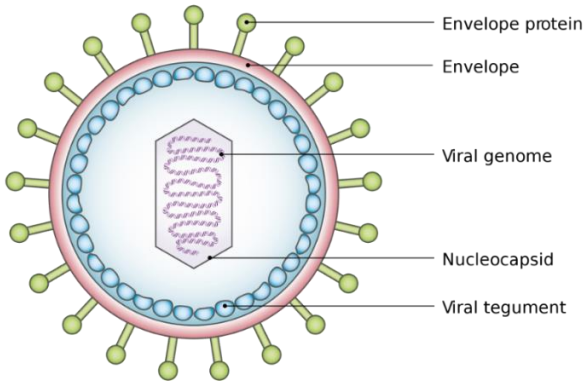

Fig 1

Structure of Corona Virus

The structure of corona virus is quite similar to what we have seen. In this virus the genome is single stranded (RNA) that is tightly packed to the centre of the virus. However, unlike other viruses, the capsid layer isn't unitary or large, it's relatively smaller and multiple in number, as if like histone proteins present on the genome. This capsid modification is preferred to be called nucleocapsid rather than capsid itself.

Corona virus also has an envelope made of phospholipids with inserted proteins. The envelope is derived from the host cell (as discussed earlier) and modified to contain spikes, smaller membranes and the viral envelope proteins.

The spikes on corona virus are recognized by receptor proteins on the host cells.

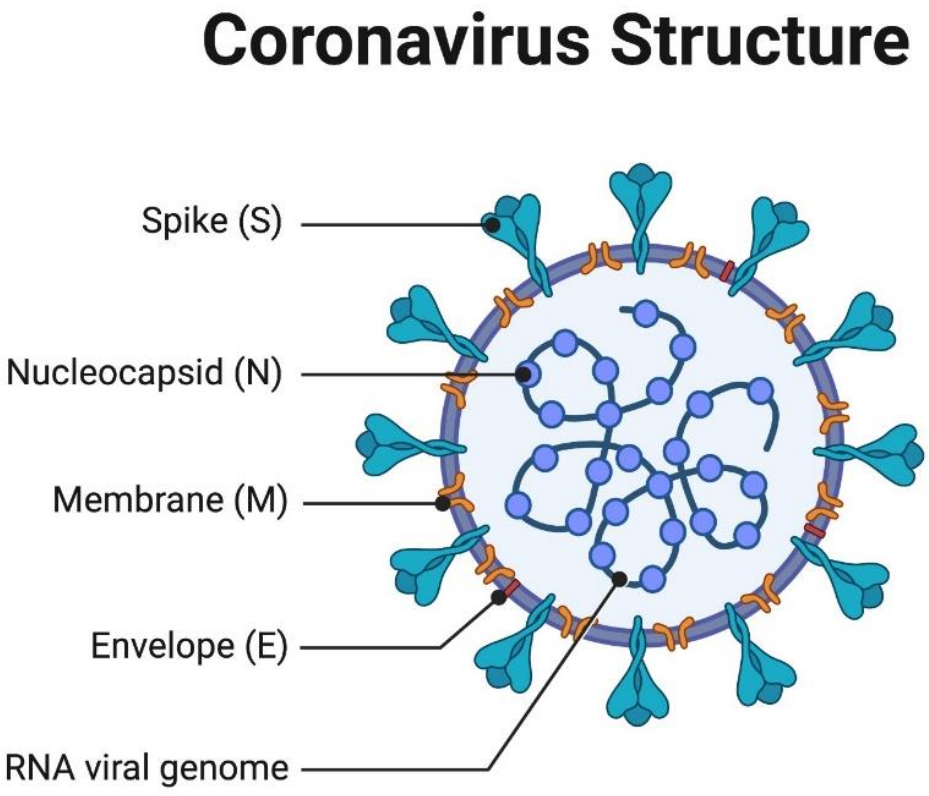

fig2

Signs and Symptoms

Corona virus is a viral disease we don't know much about yet. A lot of the symptoms that indicate that one has corona virus are similar to viral infections of the same family and other viruses like common flu.

General Symptoms

The incubation period of this disease might range from person to person but WHO suggests that it's from 2-14 days. The most common and relatively mild symptoms include **Fever, dry cough and tiredness/ shortage of breath (difficulty in breathing).** Early symptoms might also include **loss of taste and smell.**

Other common symptoms include: **Chills, dry cough, sore throat, runny nose, vomiting, nausea, fatigue, diarrhoea, headache, body aches, confusion and bluish lips/face.**

Symptoms in the Elderly

Corona virus can also cause multiple complications in patients with pre-existing diseases (specifically the elderly). A few of these complications and symptoms include: **Heart problems, kidney damage, liver problems, diabetes complications, blood clotting, seizures, fainting, stroke, etc.**

Symptoms in Children

Corona virus symptoms in children are generally mild and may even be **asymptomatic**. Rare cases include

children and infants with **acute pneumonia** that is directly linked Corona virus infection.

An extremely rare symptom of corona virus in children is the **MIS-C or multisystem inflammatory syndrome in children** that leads to multiple other severe symptoms linked to several other organs.

Asymptomatic Cases

Corona virus also has asymptomatic cases across the globe. In such a case an individual does not develop or show any symptoms even after the incubation period. The pathogen can still be communicated in this case.

Immune response

The immune system has been a mystery to human kind for a long time. Nevertheless this does not disregard its importance in anyway. It is critical to understand the immune response to any disease to be able to cure or develop vaccines for it.

During an infection

After getting a coronavirus infection, the first immune activity that takes place is the identification of foreign material in the body.

The early immune response is to deal with infection with a higher number of leucocytes. Although, this obviously is not enough. The failure to tackle the virus of the leucocytes triggers an adaptive response of the T cells at 6^{th}- 8^{th} day. These specialised immune T cells recognize infected cells. CD4+ helper T cells send signals of the situation of the disease to the brain while the CD8+ T cells kill virus infected human cells and help to control the infection.

Meanwhile, β-cells produce immunoglobulins (antibodies) to disarm the virus. If the right immunoglobulin is produced in time, the viral infection gradually stops and β-cells and T-cells decline in number.

Memory cells are left which immediately respond when come in contact with the same virus again.

After the infection

These memory cells have the right antibody receptor type stored with them, which is why most COVID-19 patients have antibodies for SARS-CoV-2 with them.

Development of these antibodies varies from individual to individual, but on average WHO and numerous other medical institutions have arrived at the average or 1-3 weeks after symptoms appear.

Vaccines do the same thing by injecting weakened viruses into the blood stream,

which results in memory cell formation without much severe symptoms formation.

Long term Effect

We have already discussed and seen what signs and symptoms coronavirus can have, and the immune response to this infection.

The last 2 sections tell us very clearly that coronavirus can effects the lungs and sometimes the brain. Since a pathogen is interacting with such delicate organs, it might also leave long term effects.

Coronavirus can have long term effects persisting for months after initial recovery. The luckier of the people to get long term effects might only face the same symptoms for a longer time period. The more severe cases however can lead to organ damage as well.

Chances of organ damage as a result of coronavirus disease might be increased in case of pre-COVID medical complications or diseases or even specific conditions like recent pregnancy.

Sometimes in case of persisting symptoms due to coronavirus can cause chronic organ damages. For example, uncured dehydration can cause chronic kidney complications or even kidney failure. Pneumonia also can lead to similar chronic results in lungs.

A few other organs/organ systems that can be affected include the gastrointestinal system, heart, brain, cardiovascular system, nervous system, endocrine system, metabolic activities, etc.

Immune Effect

While dealing with SARS-CoV-2, the immune system might also be a cause of long term effects to other organs.

In cases where the infection does not cure itself within a few weeks, the immune response causes high amounts of damage to the entire body in order to get rid of the virus; this can also be terms as collateral damage.

A milder form of this collateral damage is referred to as cytokine storm. The cytokine storm is an excess production of the cytokine protein that triggers an inflammatory response in surrounding tissue to fight the damage.

Numerous complex immune reactions (most of them which we don’t understand yet) along with several cytokine storms in an individual with COVID-19 leads to the sepsis syndrome.

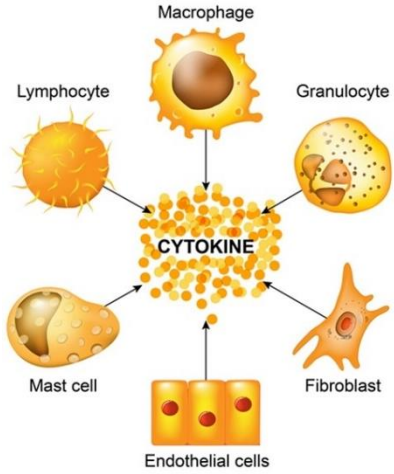

Fig 3

Tests and diagnosis

Testing and diagnosis are 2 different processes and terms. While testing is checking for viral presence in human tissue, diagnosis is checking for viral infection based on symptoms.

The nucleotides in the viral RNA of corona virus is different from that of humans. Human DNA and RNA sequences follow a certain pattern that does not match any corona virus variant. This helps in identifying corona virus genome in human tissue if present with the help of transcriptase enzyme.

The RT-PCR test uses the same principal to look for viral nucleotide sequences in human tissue using the reverse transcriptase polymer chain reaction method (hence the name ‘RT-PCR’ or reverse transcriptase polymer chain reaction).

After copying human RNA and DNA and viral RNA, individual nucleotide sequences of minimal samples (primers) are compared to give the result.

Transmission

Transmission of any disease in general is the way it spreads between a healthy individual and a carrier of the respective pathogen. There are multiple ways through which corona virus particularly spreads among people.

Droplet transmission

Corona virus is most known to spread in this way. Like many other viral infections, corona virus also spreads though the droplets in the sneeze, cough or spit of a carrier individual. When these droplets come in contact with the nose, mouth or eyes or are inhaled, they can infect a healthy individual.

Formites

Corona virus also spreads through a medium called formites. Formites is also better known as surface transmission, where a healthy individual is infected if in he/she came in contact with an infected surface and touched their eyes, nose and/or mouth.

Airborne Transmission

While corona virus isn’t completely airborne like influenza, inhalation of

droplets in the air (as discussed earlier) can lead to infection.

Prevention

The prevention of corona virus can be linked with its transmission to deduce ways of prevention. Traditional ways of prevention (that were used in the first half of the pandemic) don't include vaccination. Nevertheless, one cannot stress upon enough how important it is to get vaccinated against corona virus in order to achieve maximum immunity against it.

Wearing masks

Wearing a mask is one of the most important precautionary steps in this pandemic. Wearing masks that cover both mouth and nose help in prevention of inhalation of infected droplets, protecting both the community and oneself.

The graph below from Harvard illustrates the importance of masks:

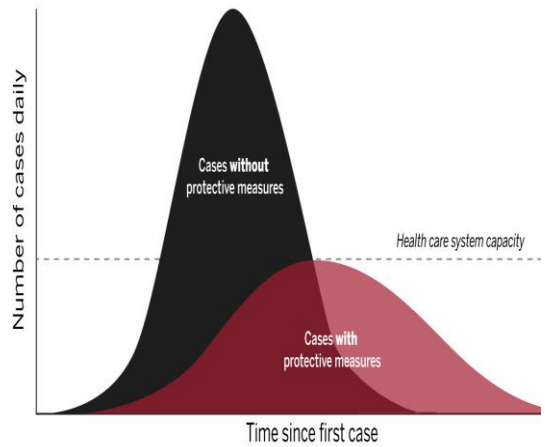

Fig 4

Social Distancing

It is important to stay at distance with other individuals who might be infected. WHO and CDC recommend a 6 feet distance with persons outside one's house. Safe distance is highly recommended with infected people inside homes.

People are also recommended to avoid overly crowded areas and areas with poor ventilation. Restriction of travel and contact with people decreases chances of infection.

Sanitizing hands

One should always wash/sanitize hands at regular intervals and after coming in contact with surfaces in public areas that might be infected. Sanitizing of hands can prevent one from passing the virus from their hands to other surfaces or face.

Other Methods

Cover coughs and sneezes

In case of absence of mask, one should always cover their cough and sneeze with a tissue paper/napkin in order to prevent spreading of potentially infected droplets.

Disinfect

Disinfecting surfaces in contact with many people also reduces chances of corona virus infection.

Look for symptoms

Everyone should always look for symptoms in oneself and close ones. In case anyone has 2 or more symptoms, they should immediately contact a doctor/family physician.

Treatment

As of now, there is no perfect cure for corona virus. While the vaccine works to prevent an infection before incidence, it cannot cure a patient with existing disease. The only method used for patients both at home and in a medical facility is supportive care. Other than supportive care and vaccines, the FDA and WHO approved certain drugs like **Favilavir, Lopinavir, Ritonavir, Chloroquine, and Remdesivir.** These drugs and medications were soon proven to be ineffective in treating the new variants of corona virus. Usually, a patient is given common antiviral drugs that might help calm down immune reactions and symptoms to the infection.

Milder infection treatment (home)

A few treatment measures to be practised for milder infections at home that can aid the immune system are listed below.

1. Stay at home and rest. Visiting other places can increase tiredness and spread the disease.
2. Fluid consumption is a must as certain infections can cause serious fluid loss leading to dehydration
3. Medically recommended drugs like acetaminophen to be taken to reduce fever.
4. All surfaces in contact to be sanitized with ethanol, isopropyl alcohol or hypochlorite solution
5. Safe distance to maintain along with wearing of mask when near other people.

Severe Infection treatment (Medical facility)

In a medical facility, most (if not all) patients have serious symptoms. One of the main reasons for being in a medical facility is for aid with breathing. Most severe cases have extreme difficulty in breathing because of which breathing support is given. For relatively milder case in the hospital, extra oxygen is delivered to the body via nose tubing or face masks.

For more severe cases, oxygen exchange is administered mechanically. This method is called Continuous Positive Airway Pressure (CPAP). An even more severe case might be aided with a ventilator. This machine has a tube put into the trachea to create a change in pressure. The change in pressure causes the lungs to inhale and exhale gases from an oxygen cylinder.

Conclusion

In this whole paper we have discussed multiple aspects and ideas on this new virus. Some of the things about SARS-CoV-2 we already knew or discovered relatively quickly after knowing that it belongs to the SARS coronavirus family. These knowns include the basic symptoms (cough, fever and shortness of breath), basic structure, family, transmission, etc.

On the other hand, there are some things that we still don't know and are critical to handling this pandemic. These unknowns include the perfect vaccine, the end of this pandemic, its variants and future mutations, etc.

We are currently seeing a lot of people across the globe not vaccinating themselves despite recommendation. Such is the reason why everyone should informed of the science behind this new invader, as this paper has aimed.

Finally, as discussed in this paper, corona virus, a truly intriguing disease, can be fought with basic care at an individual and communal level by wearing masks, sanitizing and vaccinating. If everyone follows this, the world will truly be free of SARS-CoV-2.

Bibliography

About

1. https://www.who.int/health-topics/coronavirus#tab=tab_2
2. https://www.webmd.com/lung/coronavirus
3. https://www.cdc.gov/coronavirus/2019-ncov/your-health/about-covid-19/basics-covid-19.html
4. https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus s

Structure

1. http://www.ndvsu.org/images/StudyMaterials/Micro/Structure--of-Virus.pdf
2. https://www.ncbi.nlm.nih.gov/books/NBK8174/
3. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_Introductory_Biology_(CK-12)/07%3A_Prokaryotes_and_Viruses/7.08%3A_Virus_Structures#:~:text=Viruses%20vary%20in%20their%20structure,viral%20genes%20within%20their%20genome.
4. Fig1:https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Bruslind)/08%3A_Introduction_to_Viruses

5. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Brusli nd)/08%3A_Introduction_to_Viruses
6. https://www.mpg.de/16362422/coronavirus-structure
7. https://www.frontiersin.org/articles/10.3389/fcimb.2020.587269/full
8. https://www.biophysics.org/blog/coronavirus-structure-vaccine-and-therapy-development
9. https://www.nih.gov/news-events/nih-research-matters/novel-coronavirus-structure-reveals-targets-vaccines-treatments
10. https://www.nature.com/articles/s41401-020-0485-4
11. Fig2: https://www.biophysics.org/blog/coronavirus-structure-vaccine-and-therapy-development

Signs and Symptoms

1. https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html
2. https://www.mayoclinic.org/diseases-conditions/coronavirus/symptoms-causes/syc-20479963
3. https://www.who.int/health-topics/coronavirus#tab=tab_1
4. https://www.webmd.com/lung/covid-19-symptoms
5. https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-symptoms-frequently-asked-questions
6. https://www.nhs.uk/conditions/coronavirus-covid-19/symptoms/main-symptoms/
7. https://health.ucdavis.edu/coronavirus/covid-19-information/coronavirus-symptoms.html

Immune response and effect

1. https://www.frontiersin.org/articles/10.3389/fimmu.2020.02037/full#:~:text=signature+(71).-,Immune+Response+Against+Coronavirus,19+(73%2C+74).
2. https://www.karger.com/Article/FullText/516038
3. https://www.sciencedirect.com/science/article/pii/S1876034120305670
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7480770/
5. https://www.nature.com/articles/s41392-020-0191-1
6. https://www.webmd.com/lung/coronavirus-covid-19-affects-body#1
7. webmd.com/lung/coronavirus

8. https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-long-term-effects/art-20490351
9. https://www.medicalnewstoday.com/articles/coronavirus-effects-on-body#common-cold
10. https://www.healthline.com/health-news/heres-what-happens-to-the-body-after-contracting-the-coronavirus#Immune-system
11. Fig3: https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.news-medical.net%2Fhealth%2FWhat-are-Cytokines.aspx&psig=AOvVaw16G-J_9LtF112bV_H9nQhU&ust=1636975571810000&source=images&cd=vfe&ved=0CAwQjhxqFwoTCJDM2K7fl_QCFQAAAAAdAAAAABAD

Tests and diagnosis

1. https://www.cdc.gov/coronavirus/2019-ncov/faq.html
2. https://www.biophysics.org/blog/coronavirus-structure-vaccine-and-therapy-development

Treatment

1. https://www.cdc.gov/coronavirus/2019-ncov/faq.html
2. https://www.biophysics.org/blog/coronavirus-structure-vaccine-and-therapy-development
3. https://www.mohfw.gov.in/pdf/RevisedguidelinesforHomeIsolationofmildasymptomaticCOVID19cases.pdf
4. https://www.webmd.com/lung/covid-treatment-home-hospital
5. https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/treating-covid-19-at-home/art-20483273
6. https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-treatment-whats-in-development
7. https://www.healthline.com/health/coronavirus-treatment
8. https://www.fda.gov/consumers/consumer-updates/know-your-treatment-options-covid-19
9. https://coronavirusexplained.ukri.org/en/article/vdt0008/
10. https://emedicine.medscape.com/article/2500116-overview

Transmission

1. https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-how-is-it-transmitted
2. https://www.webmd.com/lung/coronavirus-transmission-overview#1
3. https://www.cdc.gov/coronavirus/2019-ncov/faq.html
4. https://www.cdc.gov/coronavirus/2019-ncov/transmission/index.html
5. https://www.mayoclinic.org/diseases-conditions/coronavirus/expert-answers/can-coronavirus-spread-food-water/faq-20485479
6. https://www.nature.com/articles/d41586-021-00251-4

Prevention

1. https://www.cdc.gov/coronavirus/2019-ncov/faq.html
2. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public
3. Fig 3: https://www.health.harvard.edu/diseases-and-conditions/preventing-the-spread-of-the-coronavirus
4. https://health.mo.gov/living/healthcondiseases/communicable/novel-coronavirus/prevention.php
5. https://healthmatters.nyp.org/how-to-protect-yourself-from-coronavirus-covid-19/
6. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html