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The Novel Coronavirus 2019 (COVID-19)-A Review of Basic Features, Available Potential Treatments and Epidemiological Data

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ABSTRACT

The beginning of the year 2020 has come up with a pandemic of the new coronavirus. This pandemic is so much severe that before gaining any knowledge of the virus and finding any ways to confront it, a large number of people have been infected and died worldwide, even in first world countries. But, as to counter this new virus it is extremely important to know about the behavior of the virus, research efforts are going on and researchers are discovering new information about this virus every day. Initially, it was assumed that if a person has fever, sore threat and breathing problem, he may have been infected by the virus. But, later it is found that the virus may be present in a person with no such symptoms. There are various structural similarities of this virus with SARS-COV and MARS-COV. But, the behavior difference of SARS-COV-2 with SARS and MARS makes it a pandemic. Various medicines have been tried on COVID-19 infected people but no one has been proven to be 100% successful. Also, several vaccine development projects have got success on pre-clinical phase but they can't be commercialized without successful human trial which is a time consuming process. In this situation, we need to rely on social rules for avoiding coming into contact of the virus. This review study summarizes some of the basic features of COVID-19 like SARS-COV-2 structure, pathogenesis, lifecycle, symptoms found, interventions, mortality rate, diagnosis and treatments available. All these information together can help us understand the attacking behavior of the virus and finding new directions for confronting it.

Keywords: COVID-19; SARS-COV-2; Pandemic; Spike protein; ACE2

INTRODUCTION

Nature has started to heal itself with the human race retreating into the four walls of their houses as a consequence of the COVID-19 pandemic. The pandemic emerged probably in the late part of 2019. To date nearly 4.63 M of people are infected worldwide and more than 311 K people have died. Also 20% of the infected people are cured by following standard treatment available in addition to application of medicines for other diseases.

There is no medical treatment available for COVID-19 which can cure infected people with 100% success. Historically stopping deadly diseases and pandemics are best addressed by the effective herd immunity conferred by a vaccine. Unlike other medicines used for treatments, a vaccine can prevent progression to a deadly disease by proactively enhancing our immune system prior to possible exposure to the pathogen.

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Scientists, researchers, doctors, virologists of all countries are putting all of their intelligence, time and effort to find out a way to confront this virus and save human lives. As of now, there are nearly 75 projects worldwide to develop a vaccine for stopping spread of COVID-19. However most of them are in pre-clinical or clinical trial phase and may need at least a few years for completion of human trial and other options to treat the infected people are antibody therapy, convalescent plasma therapy or antiviral drugs. Antiviral drugs had limited success so far. Convalescent plasma therapy has limited success and isn't scalable since it requires blood donation from previously infected and now immune patients and antibody therapy is not available on mass scale unlike some of the repurposed antiviral drugs on trial. Hence, until any specific and successful treatment is available we vulnerable to COVID-19 and somewhat helpless with regards to this new pathogen [1].

MATERIALS AND METHODS

Structure of COVID-19

The COVID-19 virus is generally ball-shaped with some spike like structure coming out all over the perimeter as depicted in the figure below. It can also reshape and resize itself according to varying environmental condition (**Figure 1**).

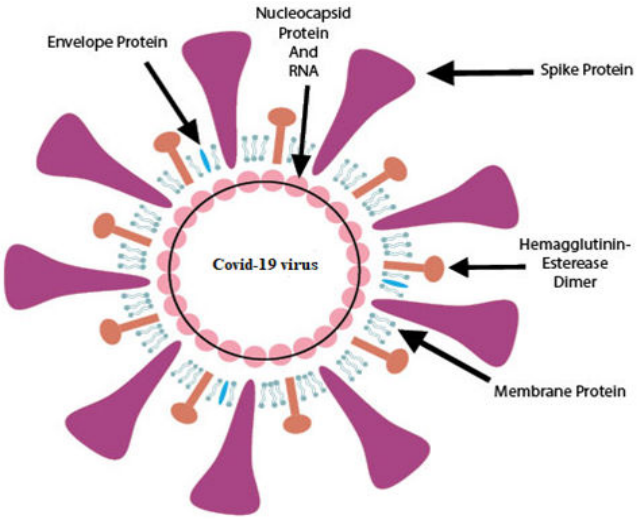

Figure 1: A 2D view of COVID-19 virus.

The outer cover of the virus contains projecting spike like structures which are composed of glycoproteins over a core portion consisting matrix proteins genetically based on positive sense single stranded RNA amalgamated with nucleoprotein. In general, the genome of the corona virus has the largest RNA genome until known, which is of 32 kilobases [2].

Four similar types of structural proteins observed in other coronavirus categories have been also identified in COVID-19 as listed below.

- Spike glycoprotein (S)
- Nucleoprotein (N)
- Membrane protein (M)
- Envelope small membrane protein (E)

Now, let us discuss about the roles of these proteins in invading the human body (**Figure 2**).

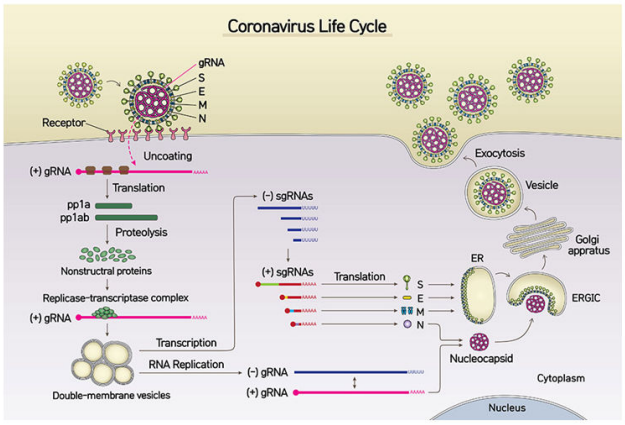

Figure 2: SARS-COV 2 life cycle.

Pathogenesis

Origin: The first documented appearance of symptoms for novel corona virus was seen on 31st December, 2019, in Wuhan city, China, when a cluster of cases of pneumonia with unknown cause was observed. On January 3, 2020, a total of 44 pneumonia cases with unknown etiology have been reported and 11 patients among them were critically ill. The official declaration of first outbreak of COVID-19 was reported by WHO on 5th January, 2020.

Tracing the origin of the virus, it was found that some of the COVID-19 cases just after that outbreak had some connection with the Wuhan seafood market, but not all the cases. It was initially thought the people infected in Wuhan with the new virus may have taken live animals sold at the seafood market as food source. Later it was found that some people having with no record of visiting the seafood market have also caught infection which proves that the virus is capable of human to human spreading. The origin of the virus is still not clear [3].

Entry and replication of the virus: This new virus spreads itself when a healthy person comes to close contact with an infected person and another infection vector is aerosol droplets from coughing or sneezing. Aerosols can reach to the lungs by breathing through nose or mouth. The event of viral duplication is supposed to occur in the nasal cavity and pharynx as well as additional duplication in the lower respiratory tract and mucus membrane in the stomach leading to presence of the virus in the blood. In this stage, the patients are usually asymptotic though some non-respiratory symptoms like liver and kidney injury, diarrhea. Like SARS-COV and MERS-COV, the entry of SARS-COV-2 to the host cell is by the help of ACE2 and TMPRS2. Once the virus gets its entrance into the host cell, the RNA genome is freed into the cytoplasm giving birth to two structural polyproteins leading to virus duplication process. Formation of nucleocapsid is carried out by a combination of genomic RNA with N protein, when newly created glycoproteins are released into golgi membrane. Then the viral replication begins to grow in the Vesicular-Tubular Cluster (VTC) and the virus replications are freed when they come into contract of the plasma membrane.

At the first week of infection, there may be no appearance of specific symptoms or may exhibit dry cough sore throat, fever and head or body aches [4].

SARS-COV-2 effects on human organs and causes of illness: The presence of this new virus in the human body can damage different organs. Let us discuss here what organs are damaged here which may lead to critical illness and even death of the patient.

The first case of new COVID-19 patient that was reported found acute lung injury in both the lungs. Structural changes in both the lungs indicated Acute Respiratory Distress Syndrome (ARDS) which occurs when tiny air sacs in the lungs are filled with fluids. Presence of high volume of white blood cells, especially lymphocytes had been noticed in both the lungs. It has been observed that the above effects in the lungs of a SARS-COV-2 infected patient are very much identical to the SARS-COV and MERS-COV infected patients. Also biopsy reports have confirmed slight accumulation of fat vacuoles and some lobular as well as portal activity in the liver. These may cause due to SARS-COV-2 or usage of drugs. Further, human heart is not directly damaged by SARS-COV-2 as lymphocyte infiltration is much lower.

SARS-COV-2 infected patients have exhibited higher white blood cell count, breathing disorders and growing amount of cytokine secretion from immune cells. As the virus targets the respiratory system, the major pathogenesis of SARS-COV-2 infection is acute pneumonia, known as RNA aemia in addition to limited air-filled lungs and critical heart disorder.

SARS-COV, MERS-COV and SARS-COV-2 infected patients exhibit acute breathing disorder which is a major symptom of ARDS leading to application of ventilation (P6_12)(P7_13)(P8_14). Past researches have demonstrated that factors affecting the occurrence of ARDS include vulnerability to hereditary gene, cytokine molecule secretion for biological confrontation of pathogens and other candidate genes [5].

Immune response: Once the host cells are infected by this new virus, the immune response of the host cell is triggered. The Antigen Presentation Cell (APC), the primary immunity system against virus initiates inflammatory cascade. Consequently, antibody-mediated immunity and intra-cell immunity with assistance from virus specified T and B cells are triggered. There are two phases of this process. In the first step, APC presents the virus antigen to CD_4^+-T-helper (Th1) cells and in the second phase APC activates Th1 cells by freeing a group of cytokines interleukin-12. As a consequence, Th1 cells in turn activate CD_8^+-T-killer (Tk) cells which attack cells containing virus antigen. Further, antigen-specific antibodies are created as Th1 cells activate B cells. According to current findings, CD_4^+ and CD_8^+ number has been observed to be substantially minimized in the circulating blood of COVID-19 infected patients.

As SARS-COV-2 enters in the host cell, an immune response like above is triggered drawing cells responsible for host immunity to the area of attack resulting in a preventive immune response in that particular locality. One effect of this immunity response is releasing of cytokines, a small protein, acting as a messenger of the immunity system. But, sometimes extreme and unmanageable amount of cytokines are freed in the blood attracting more immune cells leading to hyper inflammation. This event known as “cytokine storm” stimulates brutal confrontation by the immunity mechanism of the body, bearing the reason behind ARDS as well as multi-organ failure and death for critical SARS-COV-2 infected patients similar to what is observed in SARS-COV and MERS-COV.

Interventions

In this scenario of COVID-19 pandemic, we must put our whole effort in stopping the spreading of this novel virus as well as following proper treatment policies for the already infected people with the objective of relieving them from the threat of the virus. The pandemic can be addressed *via* pharmaceutical intervention and non-pharmaceutical intervention.

Pharmaceutical interventions: Pharmaceutical intervention is the way to protect us against the virus by application of vaccines, antiviral therapy, antibody therapy etc. The most suitable way to control COVID-19 pandemic is to follow the process of vaccination. A vaccine is actually a biological compound that furnishes extra immunity power from outside of the body in addition to built-in immune system towards COVID-19 infection. A vaccine carries nearly identical virus microorganism developed from weak or killed microbe which activates immunity power of the body. Scientists and researchers have come up with suggestions for developing COVID-19 vaccines having foundations on epitopes, mRNA and S protein-RBD framework. A synthetic genomics platform has been aided for express restoration of SARS-COV-2. There are some vaccines whose human trial has been started already [6].

Non-pharmaceutical interventions: One of the ways of controlling the COVID-19 pandemic is to development of appropriate, vaccines, application of antiviral drugs and antibody therapy for the people who is carrying this virus in their body. But, on the other hand, the people who are still not infected must be protected from the virus to minimize number of infected people and reduce load on medical infrastructure. Non-Pharmaceutical Interventions (NPI) come into play in this situation which actually refers to various schemes to be followed by general public for avoiding spreading of this new virus.

There are usually three types of NPIs that can be followed: Personal NPIs, community NPIs and environment NPIs.

Personal NPIs are the daily actions that are to be taken to protect yourself and others from infection. The COVID-19 virus spreads by human-to-human contact through mucus droplets coming out of the mouth and nose of the infected individual at the time of coughing, sneezing or talking. So the activities to be followed for avoiding infection are as below.

- Not going out except in an emergency
- Staying home if you feel sick

- Covering coughs and sneezes with hanky or back of your hand when a hanky is not available
- Frequent washing of hands using soap or hand sanitizers
- Not touching eyes, nose or mouth without properly washing hands
- Using of a mask covering mouth and nose when need to go out

Symptoms

Usually, every disease by which the human beings are attacked shows some symptoms. By identifying specific symptoms specific treatments for a particular disease is carried out. So, symptoms of a disease is a highly important aspect in identifying a specific disease, following a particular treatment with respect to the symptoms and curing the patient effected. But, in cases of newly arrived diseases like previously unknown virus infection which has similar symptoms with other common disease, it becomes tough to identify the novel disease using common symptoms. SARS-COV-2 is such a novel virus. It has various common symptoms like fever, cough and fatigue that are very much observed in other diseases. In addition to above common symptoms, there are other disorders that can be observed in a COVID-19 patient. Various disorders in human body caused by COVID-19 can be classified by systemic disorder and respiratory disorder. The symptoms under systemic and respiratory disorder have been tabulated below (**Table 1)** [7].

Table 1: The symptoms under systemic and respiratory disorder.

Disorders	Symptoms
Systemic	Fever, cough, fatigue, sputum creation, headache, coughing of blood or blood sprinkled mucus, severe heart abnormality, low blood oxygen level, breathing difficulty, low level of white blood cells, diarrhea
Respiratory	Runny nose, sneezing, sore throat, pneumonia, ground glass opacity, RNAaemia, acute respiratory distress syndrome

A great difficulty is that various above symptoms are also observed in case common cold and flu as compared in the table below (**Table 2**).

Table 2: The comparision of symptoms like cold, flu and SAR-COV-2.

Symptoms	Cold	Flu	SARS-COV-2
Fever	Rare	Yes	Yes
Cough	Mild to moderate	Yes	Yes
Fatigue	Occasionally	Yes	Yes
Runny nose	Yes	Occasionally	Occasionally
Nasal congestion	Yes	Occasionally	Occasionally
Diarrhea	Rare	Occasionally	Occasionally
Body aches	Mild	Yes	Occasionally
Sore throat	Yes	Occasionally	Occasionally
Headache	Rare	Yes	Occasionally
Loss of appetite	Occasionally	Yes	Occasionally
Breathing difficulty	Slight	Occasionally	Yes
Respiratory problem	Occasionally	Occasionally	Yes
Chills	Yes	Unusual	Occasionally
Loss of taste or smell	Occasionally	Occasionally	Occasionally

RESULTS

Diagnosis

As there are COVID-19 infections with and without symptoms and the cases with symptoms mostly resemblance with normal flu and cold, for diagnosis of COVID-19 infected people specific testing procedures targeted to identify the presence of SARS-COV-2 virus in the body is necessary. For diagnosis of COVID-19, there are two basic approaches. The first one is targeted towards identifying the presence of the virus in the body which is referred to RT-PCR test. The second one is targeted towards recognizing the presence of antibodies generated in the body due to COVID-19 infection. Except these two there are other tests that can help us detecting unusual condition of the lung. This section describes different test procedures available for diagnosing COVID-19 [8].

RT-PCR test: In Polymerase Chain Reaction (PCR), a very small and distinct portion of DNA can be magnified nearly thousand times for easy analysis and recognizing the presence of a virus, As SARS-COV-2 contains only RNA, no DNA, a reverse process of PCR referred to as Reverse Transcription-Polymerase Chain Reaction (RT-PCR) is applied for converting RNA to DNA and then a distinct potion of that DNA is amplified using PCR. A matching of this amplified DNA with genetic code of SARS-COV-2 is taken as the presence of the virus in the body. Clinical samples are collected from secretion from the nose, throat or mucus of a person for extracting RNA and results are usually accessible within a few hours to two days.

Antibody testing (serological testing): Antibody testing refers to recognizing the presence of antibodies in an infected patient's blood. Antibodies are specific proteins that generated in the blood as a result of the response of our immunity system against the SARS-COV-2 virus. This testing procedure actually looks for the presence of SARS-COV-2 induced antibodies in the blood, not the virus itself. The patient's blood is tested for the presence of two antibodies: IgM and IgG. IgM antibodies are generated in the blood during early stages of the infection and can be identified after more than couple of days of infection. On the other hand, IgG antibodies are usually traceable after 10-14 days of infection.

This test may be applied to find out the number of people that came in contact of this disease and thereby supposed to get immunity against the virus. But the antibodies produced due to SARS-COV-2 infection may not provide long lasting immunity against COVID-19 infection. Further, the performance of developed vaccines can be evaluated using this test. One important use of this test that it can help in recognizing asymptotic cases as antibodies remain present in the blood serum of an infected person.

Chest radiography (CT): CT scan images of most of the COVID-19 infected people exhibit identical shadow like patches in both lungs as well as a hazy blurry portion indicating partially air-filled lung.

That is the reason it can be usually presumed that a COVID-19 suspected patient can have a high chance of infection when the above features are available in CT scan image. In the early stages of infection, the presence of the virus may not be identified from RT-PCR test, but presence of above features in the lung image may indicate infection [9].

Newly Arriving Diagnostic Tests for COVID-19

Nucleic acid testing: For detection of SARS-COV-2 virus in the body several variations of traditional nucleic acid testing are being applied. A nucleic acid based testing strategy known as SHERLOCK aids a ribonuclease known as Cas13a for detecting various RNA structures and self-RNA. When actuated by SARS-COV-2 genome Cas13a is capable of cutting reporter RNA sequences. Another strategy following the same method of breaking up reporter RNA sequences uses an alternative nucleic acid Cas12a.

A combination of the advantages of RT-PCR and rapid testing-performance accuracy and speed-has been applied for developing a diagnostic kit which can magnify virus genome in a single heating thereby conveying result in 5-10 minutes.

Deep learning based testing: Use of computer intelligence can greatly improve the accuracy performance of the suspected COVID-19 cases by analyzing the CT images with the help of deep learning algorithms. A research project on recognizing radiological attributes with respect to the chest image of suspected cases has demonstrated of accuracy of 96%, enhancing the efficiency of correct diagnosis. This technique has already been practiced in the clinical domain.

Smartphone based testing: Though not published yet, there are a few research attempts for identifying asymptotic cases using smartphone app based techniques. One such smartphone based device called Lyfas used for early non-invasive detection of heart related diseases has been upgraded for COVID-19 detection also. A combination of Photoplethysmography (PPG) and heart rate variability have been taken as the key for identifying asymptotic COVID-19 cases which allows to minimize large number of traditional and costly tests for SARS-COV-2 detection [10].

DISCUSSION

Pandemic Modelling and its Impact on Decision Making

A pandemic situation can be framed into a mathematical model so that it becomes easier to implement social rules for COVID-19 avoidance. In the most frequently used model of epidemic spread, deterministic ordinary differential equations are employed which separates the total population into two groups: "Susceptible" (those individuals who are potentially capable of contracting the disease) and "Infected" (those individuals who are capable of spreading the disease). Based on this division of the population the model is called "SI".

There are other epidemic models also based on the classification of the total population (SIR: Susceptible-Infected-Recovered, SEI: Susceptible-Exposed-Recovered and SEIR: Susceptible-Exposed-Infected-Recovered). These deterministic models assume that populations are completely mixed and ignore spatial effects of spread epidemics; also interaction between individuals is neglected since they model populations as continuous entities. The SI, SIR, SEIR, SIS and SIRS models fail to effectively model spatial aspects of the spread of an epidemic, the individual contact process and the effects of individual behaviors, among others. For this reason, the development of new mathematical and computing methodologies is necessary.

AGM or agent based modeling is more data intensive and integration of agent based modeling with GIS could in theory be better than SIER or SIR models that ignore geographical context and interactions between individuals. It takes time and a lot of data to set up an AGM model compared to an SIR or SEIR model so absent data and computing resources agencies may default to using less effective means to simulate the pandemic over time [11].

Mortality Rate of COVID-19

As written in the dictionary of epidemiology, mortality rate refers to approximate number of people facing death within a specific period. But in case of COVID-19 pandemic the term "Case Fatality Rate" (CFR) is being used often to describe mortality rate. CFR is defined as the ratio of fatal cases for a specific pandemic during a specified time. Though both of these measures are being used alternatively in the literature, there are a basic difference between the ways of calculation. CFR is measured as the ratio of the number of confirmed deaths from COVID-19 is to the number of confirmed COVID-19 diagnosed cases. Mortality rate or death rate, on the other hand, is calculated as the ratio of the number of deaths from COVID-19 is to the total population.

As on 8th May, 2020, total number of infected people worldwide is approximately 3,759, 967 and total number of deaths is 259,474 with newly infected cases of 87,729 and deaths of 5429 recorded in previous 24 hours. In India, the number of infected cases is more than 85,000 and death toll is approximately 2752 as on 16th May, 2020.

Now, depending on how different countries are calculating the rate of death due to COVID-19 may produce different outcomes regarding actual number of deaths. Now, according to the above definitions CFR and mortality rate calculated for the world and India using above data will differ (**Figure 3**).

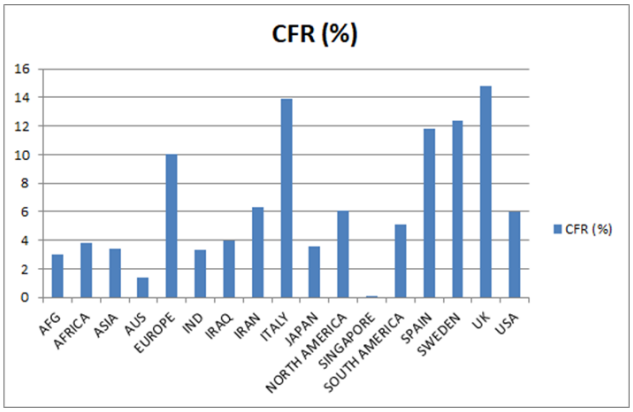

Figure 3: CFR comparison as on 8th May, 2020.

Comorbidity effect on mortality rate of COVID-19: Comorbidity actually refers to having additional medical conditions in addition to having COVID-19 infection and ongoing researches have demonstrated that comorbidities can greatly affect the death rate due to SARS-COV-2.

The first hint on the effect of comorbidities on COVID-19 infected patients came out through a research work analyzing clinical attributes of infected patients in Wuhan, China. The investigation report stated that among 41 confirmed infected cases, 13 of the patients has comorbidities including hypertension, diabetes, heart disorder and breathing difficulty due to lung disorders. Another research work targeting infected people of the same place Wuhan, China observed that critically ill patients exhibited underlying medical conditions and concluded that age and comorbidity may be a threat factor for these patients.

Treatments

At this moment, there is no specific medicine or vaccine available for treating and curing COVID-19 patients though extreme investigative experiments are being made to find specific medicines and vaccines to confront COVID-19. Various types of medicines for other diseases are being applied-mostly those whose symptoms match with that of COVID-19 as well as with those who has similar features as that of SARS-COV-2. It is a fact that these medicines have been successful for some cases, but they were unable to provide 100% success against COVID-19. In current date, nearly 100 research projects on COVID-19 vaccine development are going on worldwide. But most of them are in human trial phase whose successful completion can take at least 18 months of time if we think in the most optimistic way. This section summarizes various potential treatments being applied and leading vaccine development researches.

Antiviral drugs: Chloroquine and hydroxychloroquine are anti-malarial drugs that exhibit the property of being effective against viruses which actually stands in the way of ACE2. It has been observed from biological study conducted in test tube that chloroquine can efficiently stop SARS-COV-2.

Initially these drugs have been proved to be effective to minimize the lung infection due to COVID-19. But, later it was understood that both the drugs come with grave side effects such as damaging of retina, low blood sugar, irregular heartbeats and damage of heat muscles. Several COVID-19 infected patients in a hospital in Brazil exhibited arrhythmia after high dose chloroquine were prescribed and consequently 11 patients died. As a result clinical trial being carried out in that hospital was stopped. However the clinical trials of chloroquine should be continued by applying correct doses to avoid side effects.

Plasma therapy: Due to absence of any immediate antiviral or vaccine treatments of COVID-19, techniques used in the past have come out as means to confront the pandemic. One of such techniques is Convalescent Plasma (CP) that is an approach to build immunity against diseases in an indirect way. In this method, blood components not having any role in blood clotting are collected from COVID-19 cured patients through the process of blood donation. In the blood components of the cured persons the antibodies against the virus are generated which has the capability of neutralizing the virus.

In an investigative research focusing on the presence of any benefits of applying plasma therapy on five COVID-19 infected severe patients has been conducted which observes that this therapy is enhancing the clinical nature of the infected patients. Along with China and US, India also has given consent on preparing protocols for carrying out clinical trials on plasma therapy. Nearly 20 plasma therapy clinical trials are going on worldwide which includes a large-scale trial in Mayo clinic, US. Indian Council of Medical Research (ICMR) has taken the initiative in this regard. It hast to be kept in mind for collecting high neutralizing antibody, the period of recovery from COVID-19 must be appropriate before plasma collection.

Monoclonal antibodies: Monoclonal antibodies are one of the classes of immunomodulating agents that are responsible of activating or inhibiting our immunity system for helping the body to counter various diseases. For effective treatment for COVID-19, we need to find out ways by which the virus life cycle can be interrupted or binding and entry of the virus to the host cell can be blocked. This is possible by application of monoclonal antibodies. As application of monoclonal antibodies attacking spike proteins in SARS-COV and MARS-COV exhibited encouraging outcome in test tube as well as in living organisms, it can be assumed that combination of various monoclonal antibodies can be proved to be effective against COVID-19 also. Recently Israeli scientists have found out monoclonal antibodies that are effective in making SARS-COV-2 neutral.

Other therapies: One of the most important ways to stop entry of SARS-COV-2 in the host cell is to obstruct the binding process of S protein with ACE2. ACE2 is an essential part of a hormone system called Renin Angiotensin System (RAS) responsible for balancing blood pressure, fluid and electrolyte and control resistance to blood flow. ACEI and AT1R, which are RAS inhibitors can be applied as prospective tools for countering SARS-COV-2. The cytokine storm can be minimized by the application of antiviral drugs, blocking of FcR receptor and ACE2-mesenchymal stem cells transplantation within the vein and can be proved to be effective strategies for treating critical COVID-19 patients.

Further, research says that Chinese herbal medicines used for treating viral respiratory disorder can be taken as a potential therapy for treating COVID-19 patients. Also, researchers are making attempt to find medicines from unani and homeopathy field for treating COVID-19 patients [12].

Current Status of COVID-19 Vaccine Development

Right now, there is no vaccine available for COVID-19, though various vaccine development projects are under clinical and pre-clinical trial worldwide. According to a report published by WHO on 20th April, 5 candidate vaccines are under clinical trial and 71 candidate vaccines are under pre-clinical stage.

A brief description of leading vaccine development projects for COVID-19 has been given below.

A vaccine named “ChAdOx1 nCoV-19” under phase 1 clinical trial has been developed by university of Oxford fuses the genetic material of SARS-COV-2 with most fragile breed of adenovirus enabling the body to recognize the spike protein.

Vaccines developed using mRNAs carries mRNA encoded antigens that are translated into host cells by the process of vaccination. As this viral protein is identified by the body, the body immunity is activated. Moderna, a company located at Massachusetts has taken up a project jointly with National Institute of Allergy and Infectious Diseases (NIAID) of developing RNA based vaccine. Their current product mRNA-1273 is under phase 2 trials.

Sinovac biotech, a Chinese company has made an experiment on monkeys by injecting a prospective vaccine PiCoVaac which exhibited that the SARS-COV-2 infected monkeys are greatly protected from the virus. Soon, this vaccine will undergo human trials.

Overall Findings

The following observations can be made from the above discussion.

- There is no medical treatment available for COVID-19 which can cure infected people with 100% success.
- The COVID-19 virus is generally ball-shaped with some spike like structure coming out all over the perimeter.
- The spike protein (S) has the main role of attaching itself to a human cell which are composed of type I membrane glycoprotein and makes the antibodies neutral.
- This ACE2 enzyme acts as the gateway of the virus when COVID-19 attaches itself to ACE2 by the spike and that’s why it is referred as the receptor.
- SARS-COV-2 is a RNA based virus.
- The SARS-COV-2 has a genetically closed relation with previous coronaviruses like SARS and MERS.
- Scientists and researchers think that SARS-COV-2 also has been originated from bats and a mutated version of it is infecting human race.
- Ratio of the number of confirmed deaths from COVID-19 is to the number of confirmed COVID-19 diagnosed cases.

The CFR may change over time from initial stages of outbreak to the later stages.

- Age and comorbidity may be a threat factor for severely infected COVID-19 in patients.
- Potential treatments of COVID-19 include antiviral drugs, plasma therapy, monoclonal antibodies etc. But to date, no treatment method has not become 100% successful.
- The antiviral drug that is showing most promising result to date for treating COVID-19 patients is remdesivir which is actually used for treating Ebola virus.
- Right now, there is no vaccine available for COVID-19, though various vaccine development projects are under clinical and pre-clinical trial worldwide [13].

CONCLUSION

Health care systems worldwide are struggling to cope with the first modern pandemic but in this age we have modern tools to aid us and guide us in controlling the pandemic unlike in the past. Focused efforts on mass testing and isolation of positive and probable cases have proven to be effective tools for breaking the chain of transmission. It is near impossible for a resource strapped country to test everyone and testing isn't a onetime thing. Quicker and more efficient testing regimes may help. Vaccines and antivirals take time to develop and we need to take action on this urgent pandemic now to reduce transmission rate.

In essence, all the countries continue fighting together against COVOD-19 pandemic by following basic rules to avoid SARS-COV-2 as well as carrying out research for finding effective treatments so that more infected people can be saved and mortality rate can be reduced.

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