TOURO COLLEGE & UNIVERSITY SYSTEM

The Science Journal of the Lander College of Arts and Sciences

Volume 15
Number 1 *Fall 2021*

5-9

2021

Developing Approaches Towards the Treatment of Covid-19

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Abstract

In late 2019 a newly identified strain of coronavirus, SARS-CoV-2 emerged, causing a worldwide pandemic of respiratory illness, Covid-19. Covid-19 has drastically transformed the world in numerous ways. The virus is highly contagious and, in some cases, fatal. A successful cure has not yet been discovered and therefore society is urged to take proper precautions to prevent the spread of the potentially fatal virus. This paper analyzes the proper precautions that should be taken as well as the ongoing research that has been done to stop the spread of the virus.

Introduction

The novel Corona Virus, the underlying cause of Covid-19, is an infectious virus that primarily affects the respiratory tract. It was first diagnosed in 2019 in Wuhan, China where thousands of people were stricken with the virus. The virus eventually spread across the globe and was eventually categorized as a global pandemic. Symptoms of Covid-19 include fever, cough, difficulty breathing, shortness of breath, muscle fatigue, and loss of smell or taste. Recent studies revealed that Coronavirus impacts the gastrointestinal tract causing nausea, vomiting and diarrhea (Clinical Trials Week, 2020). While most people with the virus portray mild symptoms, a small but significant percentage of people develop more serious symptoms such as pneumonia which can be fatal. Elderly people, individuals with preexisting health conditions, as well as people with compromised immune systems are at the greatest risk for developing the most serious symptoms.

The virus is highly contagious and spreads, most commonly, through small droplets via coughing and sneezing. Additionally, people may catch the virus by touching a surface that is contaminated, followed by then touching their face (Mohan, 2021). Therefore, the Centers for Disease Control (CDC) enforce face coverings such as masks or bandanas to minimize transmission through droplets. The CDC strongly recommends people to properly social distance and stay six feet apart from each other to prevent the spread of the virus. Additionally, people are advised to constantly wash their hands with soap for roughly twenty seconds to rid themselves of any viral particles that they may have encountered.

Symptoms may not develop for two to seven days after coming in contact with the virus, which may make affected people unaware that they are infected, and which strongly contributes to the mass spread of the virus. Although Covid-19 is highly contagious, it is most contagious during the first three days that the patient exhibits symptoms. The incubation period for the virus is roughly two to fourteen days, and, therefore, patients who experience symptoms are strongly recommended to isolate themselves for fourteen days (Deibie, 2020). Currently, there are no proven drugs or vaccines to combat the virus and thus prevent the spread. However, over the past several months a great deal of covid-19 research has been performed to meet the global demand. Researchers have been experimenting with several anti-viral drugs that may disrupt the viral proteins and ultimately stop the virus. Additionally, there are numerous vaccines that are being manufactured and researched that can possibly immunize society and thereby stop the spread of the lethal virus.

Discussion

As noted, there is no current treatment which has proven to be effective in combatting the virus. Researchers recognize that it is impossible to kill the virus and are, therefore, working to "deactivate" the virus so that it can not spread further. Dozens of pharmaceutical companies, as well as thousands of researchers are working on producing a vaccine as well as seeking treatments and medications to help combat the virus. Vaccines typically contain an antigen, consisting a weakened or dead strain of the virus. When introduced to the bloodstream, the antigen triggers the immune system to produce antibodies towards that specific antigen. Researchers are trying several methods to produce a vaccine in hope to find a preventative cure for the lethal Coronavirus.

One approach that researchers are experimenting with is with a DNA vaccine. A DNA vaccine simply delivers genetic instructions how to build a viral protein. A DNA vaccine does not introduce the entire virus to the body, rather, it contains nucleotides that encode a portion of the virus. Upon injection, the nucleotide travels to the cell where it gets translated and a protein product is produced in the form of messenger RNA. The mRNA then assembles viral proteins which the immune system recognizes and tries to conquer. Researchers in China have used this approach and found particular genes that code for the spikes in the coronavirus, specifically genes which code for the receptor binding domain. The receptor binding domain is the unit of the virus that is found externally and on surfaces and are, therefore, the primary contributors for spreading the deadly virus. DNA plasmids are placed in the vaccine and, when injected into the body, they target the genome upon which they are translated into proteins, thereby introducing the cell to traits of coronavirus which initiates the production of antibodies. The cells then secrete the antibodies into the bloodstream which stimulate the B and T cells to act accordingly (Lee et al, 2020). The advantage of DNA and RNA vaccines is that they can be produced quicker than typical vaccines. (The usage of DNA vaccines is an emerging field and is rapidly developing.)

Another method that may be beneficial is the introduction of similar virus like particles into vaccines. These particles are not actual viruses and therefore do not cause disease. Yet, these particles prepare the immune system for what the virus proteins look like so that it can produce antibodies prior to coming in contact with the actual virus. When combatting the coronavirus, some researchers believe that by inserting some adenovirus into the vaccine, it will familiarize the cell to traits of coronavirus and thus prepare the body to fight off the corona virus when the two encounter. The adenovirus is missing one its own genes which prevents itself from reproducing and is therefore nonhazardous. When the adenovirus is injected, it places information into the cell by unraveling the gene, which then stimulates the immune system to produce antibodies. A strand of DNA that codes for coronavirus is inserted into the missing genes which trigger the body's immune response thus deactivating specific genes that are found in the coronavirus (Khadilkar, 2020). This method has been effective for the HPV vaccine that was introduced in 2006 and researchers are hopeful that this method will also be effective for combating the coronavirus.

Antibiotics are generally used to fight bacterial infections and are, therefore, ineffective for coronavirus. Accordingly, researchers are trying to create and find an effective antiviral medication. There have been several medications and treatments that have undergone trials but not yet proven to combat the coronavirus.

In September 2020 international clinical trials tried a new approach to combat the virus by using steroids. Steroids are often used by doctors to alleviate inflammation as well as to relax the immune system to prevent an overresponse. Patients who are seriously ill from coronavirus are at greater risk of dying from the immune system's overreaction to the virus, rather than from the actual virus itself (Lee et al., 2020). Accordingly, researchers hope to treat these patients with steroids to relax the body and prevent it from overreacting before the inflammation becomes serious and, in some cases, fatal. Researchers at Oxford University found that dexamethasone was extremely effective when given to critically ill patients. In addition, the World Health Organization (WHO) carried out studies using hydrocortisone and methylprednisolone on critically ill patients. The steroids were given to seriously ill patients and a surprising number of the patients did not require mechanical ventilation. Moreover, death rates were lowered with the patients who took these drugs (The Times, 2021). However, like many other drugs, steroids can cause serious side effects such as raising the body's blood glucose levels and causing confusion in the patient. Therefore, optimal doses of steroids need to be established prior to treating patients with steroids on a larger scale. Nevertheless, many researchers are confident that steroids will eventually be an effective tool in fighting the coronavirus.

Another approach to treating the coronavirus is with the drug hydroxychloroquine. Hydroxychloroquine is a less toxic derivative of chloroquine which was developed decades ago to prevent and treat malaria (Liuzzo, 2020). It is now commonly used for other diseases such as lupus and rheumatoid arthritis. Hydroxychloroquine works by regulating the immune system. The exact mechanism through which hydroxychloroquine benefits Covid-19 patients is unclear. As mentioned earlier, many patients with Covid-19 develop severe complications due to the body's aggressive immune response upon perceiving the virus. Researchers are hopeful that hydroxychloroquine can prevent the immune system from over responding which will in essence, reduce the unnecessary inflammation. Initially, when the virus first reached the United States, the Food and Drug Administration (FDA) approved the emergency use of hydroxychloroquine. However, after experimenting with the drug, researchers did not find sufficient supporting evidence that it is a safe and effective treatment for coronavirus. A clinical study using hydroxychloroquine did not demonstrate the ability to alleviate symptoms and shorten hospital stays (Liuzzo, 2020). Therefore, in June 2020 the FDA banned the usage of the drug until additional research on safety and efficiency of the drug was performed. While there is some evidence that the drug is effective, it has not been estimated that the potential benefits outweigh the risks. Some risks of hydroxychloroquine include heart disease, headaches, dizziness, and vomiting. In addition, patients suffering from malaria and other diseases, who are dependent on hydroxychloroquine, were unable to obtain the drug because it had been used widely for patients suffering from Covid-19.

Another drug that is being experimented as a potential cure is Remdesivir. Remdesivir was first developed in 2009, by Gilead Sciences to help treat patients suffering from Hepatitis C. Unfortunately, Remdesivir did not prove to be effective in fighting against Hepatitis C. In the following years, scientists experimented with Remdesivir as a potential cure for Ebola, and then again in 2020 for coronavirus (The New Nation, 2020.) Remdesivir serves as a broad-spectrum antiviral medication that is used to treat single stranded RNA viruses such as Ebola and coronavirus. This class of medication targets and inhibits RNA replication through various mechanisms (Nguyen et al, 2020). In regard to coronavirus, Remdesivir works as a pro-drug, meaning, that after it is infused, it is then

metabolized into its active form and converted into a ribonucleotide analogue, more specifically an adenine nucleotide analogue.

RNA is composed of four nucleotides including Adenine (A), Guanine (G), Cytosine (C), and Uracil (U). When coronavirus replicates, it takes these nucleotides that serve as the building blocks for the virus, and then chains them together thus allowing itself to replicate. Remdesivir serves as an adenine nucleotide analogue, and therefore inhibits viral replication. Thus, during viral replication attempts, Remdesivir is incorporated into the RNA in place of adenine. This essentially stops transcription of the viral genome by preventing the building blocks from being available to properly form the virus. Moreover, it ultimately reduces the body's viral load which gives the body an opportunity to combat the viral cells that were replicated prior to taking Remdesivir (Drugs and Therapies, 2020).

Currently, Remdesivir is in the investigational stage and has not yet been FDA approved as a safe treatment for any sort of disease. However, in May 2020, the FDA authorized the emergency use of Remdesivir via intravenous (Drugs and Therapies, 2020). Optimal doses of Remdesivir have not yet established and are under investigation.

Another approach that is being tested is the usage of convalescent plasma. When patients recover from Covid-19 their blood plasma contains antibodies that are able to fight off any future encounters with the virus. In the current situation, patients with antibodies who are eligible to donate plasma do so and the plasma is then transfused into a needy patient. The donor's antibodies may aid the patient in fighting off the virus as well as possibly shortening the length or severity of the illness. The concept of convalescent plasma has been used widely for decades to help patients recover from certain diseases such as chickenpox, measles and polio (Janice, 2020) (CotentEngine, 2020). Researchers still do not know how effective this approach will be with the coronavirus. Nevertheless, the FDA has approved the emergency usage of this treatment option. There are currently multiple studies being run that are testing the validity of this treatment. Although the evidence is not completely clear, the FDA determined that convalescent plasma has a great likelihood of improving symptoms as well as shortening hospital stays. In addition, it is estimated that the potential benefits outweigh the possible risk factors of the treatment. Risk factors include allergic reactions, lung damage and in some cases pulmonary embolism (Sanfilippo et al. 2020). These risk factors are low since donors must be completely recovered from the virus for at least two weeks prior to donating plasma. Some doctors believe that this is the most effective form of treatment when given to a patient during the beginning stages of the virus in as early as three days onset. (Newswire, 2020).

There are two categories of medicine- preventative and curative. Preventative medicine aims to promote and maintain health as well as prevent disease by living a healthy lifestyle. Vaccines fall under this category because they promote health by preventing disease and illnesses. On the other hand, curative medicine seeks to aid individuals who have already contracted a disease and have fallen ill, this includes treatment and medications. In regard to coronavirus, there has not been a successful preventative or curative treatment plan proven mainly because the virus has roughly 380 different mutations. Mutations occur through viral replication. When the virus replicates, the genetic code does not always exactly duplicate resulting in mutation. Over time, parts of the coronavirus genome have expanded into many mutations which contributes to the struggle that researchers are facing. Additionally, over time new strains of viruses evolve. Researchers have not found evidence that the different mutations and strains had significant change in how the virus affected society. However, with new data being observed and recorded researchers are optimistic that there will be a vaccine by the end of 2020 as a preventative measure towards the lethal virus.

Viruses are the most abundant biological entity on earth. They are simple nucleotides consisting of genetic material cased in a protein shell and capable of surviving only in another living cell. When a virus enters a living cell the immune system perceives the threat and begins to battle it. However, in some instances the immune system is not trained to fight off a specific germ or virus, causing the pathogen to overpower the immune system, and cause illness. Once a pathogen suppresses the cell, it replicates itself and kills the cell thus releasing particles so that it can infect more healthy cells.

Researchers believe that when facing a new virus, detection and containment are two keys that can help fight it off. Experts realize that when they are dealing with a new virus it is essential that they figure out the gene sequence so that they can create test kits so doctors can test to see whether or not patients are infected by that particular virus. After detection, containment is vital, because once a virus reaches the human population it spreads rapidly. Each virus has a different method of spreading. Coronavirus in transmittable through respiratory droplets, mainly in the forms of spray such as coughing and sneezing. Researchers are doubtful the virus will go away on its own and are, therefore, working to create lines of defense such as vaccinations as well as seeking proper treatment and medications. As discussed numerous researchers are working on producing a vaccine

that can highly limit Covid-19 and potentially eradicate it. However, vaccines need to go through strict testing and experimenting before they become available to the market. This process can take months and sometimes even years. This contributes to the struggle researchers are facing being that viruses are notorious for changing and adapting to the environment, which makes it difficult to nail down a precise vaccine. In addition, the WHO is testing many drugs that are used for illnesses, but just like vaccines this process can take a while. With all of this on the rise, society is urged to stay calm and not panic. Modern technology and further research prepare us better than previous pandemics in history. Nevertheless, the virus has had catastrophic consequences, however, if people stay vigilant and quarantined when told to do so, the spread of Covid-19 can be greatly slowed down until a cure is found.

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