Covid-19 treatment and prevention methods

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Abstract

Humans lack immunity to many pathogens that are common in animals. Covid-19 is a virus that is believed to have jumped from animals to humans and has caused a global pandemic within a short span of eight months. Societies are adapting to new lifestyle practices to prevent spread while research teams are racing to find a medical solution. In this research review article, I review the various mechanisms by which the virus is thought to infect humans, several pathways that are being pursued to find a vaccine, and prevalent treatments.

I. Mechanism of Covid 19

The coronavirus molecule consists of 4 different proteins, Nucleocapsid (N) protein, Membrane (M) protein, Spike (S) protein and Envelop (E). Each of these proteins perform a different function in entry, hijacking, and replication of the body cells. In order to enter your body, the S proteins on the virus binds itself to the ACE2 receptors (protein generating enzymes that regulate various body processes such as blood pressure and inflammation) which are present in the lungs, throat, and kidneys. Then, a serine protease called TMPRSS2 activates one of the major proteins present on the coronavirus, called the spike protein domain. Recent studies have shown that ACE2 and TMPRSS2 are present abundantly in the cornea of the eye and the nostril, which is why the eyes and the nose are major entry points for Covid-19. The virus then fuses itself onto the respiratory epithelium (the epithelial layer that lines the nose, mouth and trachea) and deposits its RNA, which is bound to the N protein. The cell starts to read the coded information of the RNA and starts to produce proteins that help in creating replica proteins of the virus. Organization and initiation of coronavirus assembly is done by the M protein, though the E protein also plays a vital role.

Within minutes of coronavirus entering our body, our immune system spots the antigens present on the virus and sends macrophages to engulf the virus, leaving behind dendritic cells. These dendritic cells then activate another immune cell called T-cells (which are lymphocytes produced in the thymus gland). These T cells produce the protein cytokine, which act as molecular communicators and allow other immune cells to attack the virus. When the protein cytokine is produced in excess, immune cells start attacking not only the virus, but also healthy tissues. This is called a cytokine storm. Cytokine storms can result in blood clots throughout the body, which further leads to organ damage since all organs need to receive blood, and high fevers. Studies have shown that many Covid-19 patients' deaths may be linked to cytokine storms.

II. Methods of prevention

Methods of prevention can be classified into two broad categories: lifestyle changes such as maintaining hygiene, and vaccine development and administration.

Lifestyle changes by maintaining good hygiene includes coughing into your elbow or a tissue, washing your hands with soap for at least 20 seconds, wearing a mask to prevent aerosols from spreading, staying

at least 6 feet away from people in public places, etc. To be effective these measures need to be practiced by the entire society which has proven to be impossible in every country that Covid-19 has affected so far.

Many institutions are currently in the process of developing vaccines for Covid-19. Most are taking one of these three pathways: (a) mRNA vaccines (vaccine that contains RNA codes which when entering the host cell, initiate production of antibodies), (b) inactivated vaccines (vaccine that consists of inactivated pathogen particles), or (c) recombinant protein sub unit, which consists of only the disease-causing proteins (antigens) of the virus and (d) Adenoviral vectors (use a weakened form of the adenovirus, a DNA virus, which causes colds in chimpanzees).

For example, Moderna has created an MRNA vaccine. This method is promising since it's inexpensive and can be mass produced easily. Moderna is currently on stage 3 of vaccine development.

The Jenner Institute at Oxford University in collaboration with AstraZeneca has created a vaccine that uses modified version of the adenovirus found in chimpanzees. This vaccine has been found to lead to production of antibodies and T cells that fight off the virus. So far, no serious side effects have been observed and further trials should be starting in a few weeks. It is currently on its final phase of trials.

Finally, Bharath Biotech has created COVAXIN, and inactivated vaccine developed from coronavirus strains. It has recently been approved for phase 2 and 3 testing.

III. Methods of treatment

Covid-19 has been treated effectively in patients without complications using general methods of treatment that are applicable for all viral infections. The key to success for this is that the patient has to be diagnosed during early stages of infection and isolated quickly.

Existing antiviral treatments have also shown to be very effective in patients who do not respond to common antiviral treatments. Remdesivir, a common drug used to treat SARS and MERS, two earlier coronaviruses like Covid 19, and also Ebola has been proven to be effective. Research shows that this drug limits the spread of Covid 19 in the body. Studies done by both New England Journal of Medicine and The Lancet show that patients who received Remdesvir recovered from coronavirus faster.

Another existing drug that is used is Chloroquine/ Hydroxychloroquine. Research has shown that this drug prevents cytokine storms of the immune system, which is a major cause for death in most Covid 19 patients. Both Chloroquine and Hydroxychloroquine limit the coronavirus' ability to replicate. Furthermore, Chloroquine decreases the capability of the ACE2 receptors in the body to bind to coronavirus.

Lastly, treatment can be done using convalescent plasma, which is widely used to treat SARS and chickenpox. In this method, plasma, the clear component of blood containing antibodies, is taken from previous Covid-19 patient and transferred to the recipient. This treatment method is still undergoing experimentation and trial. A potential risk in this method is that the plasma could transmit other diseases and vectors such as HIV.

IV CONCLUSION

The challenge presented by the Covid-19 pandemic has been formidable and calls for use of many tools to fight the virus. Enforcement of lifestyle changes such as personal hygiene, and social distancing provide

tactical tools to combat the spread of the virus. Long term and sustainable solutions through medical treatment and prevention are rapidly evolving and could potentially consist of the genetically engineered vaccine created by Moderna and the antiviral drug Remdesvir. I think that the vaccine created by Moderna is the most probable vaccine candidate since it has been successful in creating a strong immune response and preventing spread of the virus in the body. Out of all the vaccines being tested, it is in the farthest phase of trial. Since Remdesvir has been proven to help Covid patients recover quickly and was also effective against similar viruses, it would make a good long term treatment method for patients. However, implementing the solution for the entire population will continue to be a challenge for several more years.

V CITATIONS

1. How does coronavirus enter our body and can it transmit sexually . https://www.indiatoday.in/coronavirus-outbreak/story/new-covid-19-debate-how-does-coronavirus-enter-our-body-and-can-it-transmit-sexually-1671632-2020-04-27. Accessed July 31, 2020.
2. What is the ACE2 receptor?. https://www.asbmb.org/asbmb-today/science/051620/what-is-the-ace2-receptor. Accessed July 31, 2020.
3. Coronavirus: what COVID-19 does to your body and lungs. https://www.netdoctor.co.uk/conditions/infections/a31987544/coronavirus-body-lungs/. Accessed July 31, 2020.
4. CRISPR: A game-changing genetic engineering technique . http://sitn.hms.harvard.edu/flash/2014/crispr-a-game-changing-genetic-engineering-technique/. Accessed July 31, 2020.
5. COVID-19 infection leads to cytokine storm - Health Vision India. https://healthvision.in/covid-19-infection-leads-to-cytokine-storm/. Accessed July 31, 2020.
6. Coronavirus: what COVID-19 does to your body and lungs. https://www.netdoctor.co.uk/conditions/infections/a31987544/coronavirus-body-lungs/. Accessed July 31, 2020.
7. What Coronavirus Does to the Lungs | Johns Hopkins Medicine. https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/what-coronavirus-does-to-the-lungs. Accessed July 31, 2020.
8. Emily Bamforth cleveland.com. How the Moderna vaccine works, and what it means for coronavirus pandemic. cleveland. https://www.cleveland.com/news/2020/05/how-the-moderna-vaccine-works-and-what-it-means-for-coronavirus-pandemic.html. Published May 20, 2020. Accessed July 31, 2020.
9. Evan MacDonald cleveland.com. Coronavirus and the lungs: Does COVID-19 cause more severe pneumonia or ARDS than other viruses? cleveland. https://www.cleveland.com/coronavirus/2020/03/coronavirus-and-the-lungs-does-covid-19-cause-more-severe-pneumonia-or-ards-than-other-viruses.html. Published March 25, 2020. Accessed July 31, 2020.

10. Get the facts about a COVID-19 (coronavirus) vaccine. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-vaccine/art-20484859. Published June 10, 2020. Accessed July 31, 2020.
11. PhD JS-S. Clinical Trial Phases: What Happens in Phase 0, I, II, III, and IV. Healthline. https://www.healthline.com/health/clinical-trial-phases#phase-iii. Published August 24, 2040. Accessed July 31, 2020.
12. Publishing HH. Coronavirus Resource Center. Harvard Health. https://www.health.harvard.edu/diseases-and-conditions/coronavirus-resource-center. Accessed July 31, 2020.
13. What Coronavirus Pneumonia Is and Why It's So Dangerous. U.S. News & World Report. https://health.usnews.com/conditions/articles/what-is-coronavirus-pneumonia. Accessed July 31, 2020.
14. Corum J, Zimmer C. How Coronavirus Hijacks Your Cells. The New York Times. https://www.nytimes.com/interactive/2020/03/11/science/how-coronavirus-hijacks-your-cells.html. Published March 11, 2020. Accessed July 31, 2020.
15. TheVaccineMom. Subunit Vaccines. The Vaccine Mom. https://www.thevaccinemom.com/vaccine-immunology/vaccine-types/subunit-vaccines/. Accessed July 31, 2020.
16. BerkeleyJr. Coronavirus vaccine from Oxford and AstraZeneca shows positive response in early trial. CNBC. https://www.cnbc.com/2020/07/20/oxford-universitys-coronavirus-vaccine-shows-positive-immune-response-in-an-early-trial.html. Published July 20, 2020. Accessed July 31, 2020.
17. Gunasekar A, Kumar P, Srinivasan C. India's COVID-19 Vaccine Trial "Marks Beginning Of The End": Centre. NDTV.com. https://www.ndtv.com/india-news/india-covid-19-vaccine-trial-marks-beginning-of-the-end-centre-2257525. Published July 5, 2020. Accessed July 31, 2020.
18. Basu M, here Penter your name, - P, - AG, - KS. All about Bharat Biotech's Covaxin, India's first indigenous Covid vaccine candidate. ThePrint. https://theprint.in/health/all-about-bharat-biotechs-covaxin-indias-first-indigenous-covid-vaccine-candidate/455028/. Published July 5, 2020. Accessed July 31, 2020.
19. Palca J. All You Wanted To Know About Coronavirus Vaccine Science But Were Afraid To Ask. NPR. https://www.npr.org/sections/health-shots/2020/06/24/881704736/all-you-wanted-to-know-about-coronavirus-vaccine-science-but-were-afraid-to-ask/. Published June 24, 2020. Accessed July 31, 2020.
20. Publishing HH. Treatments for COVID-19. Harvard Health. https://www.health.harvard.edu/diseases-and-conditions/treatments-for-covid-19. Accessed July 31, 2020.
21. agiannini@businessinsider.com (Ally Giannini BH. Hydroxychloroquine, what it is, and what it does to your body. Yahoo! News. https://news.yahoo.com/hydroxychloroquine-does-body-183000326.html. Published July 28, 2020. Accessed July 31, 2020.
22. Peccoud J. Labs experimenting with new (unproven) methods to create coronavirus vaccine fast. Medical Xpress - medical research advances and health news. https://medicalxpress.com/news/2020-03-labs-unproven-methods-coronavirus-vaccine.html. Published March 27, 2020. Accessed July 31, 2020.

23. Valsler2020-04-03T14:30:00 01:00 B. Remdesivir. Chemistry World. https://www.chemistryworld.com/podcasts/remdesivir/4011451.article. Published April 3, 2020. Accessed July 31, 2020.
24. Vaccine Types. Vaccines. https://www.vaccines.gov/basics/types. Accessed July 31, 2020.
25. [Video]. COVID-19 - YouTube. https://www.youtube.com/watch?v=PWzbArPgo-o. Accessed August 15, 2020.
26. Dozens of COVID-19 vaccines are in development. Here are the . https://www.nationalgeographic.com/science/health-and-human-body/human-diseases/coronavirus-vaccine-tracker-how-they-work-latest-developments-cvd/. Accessed August 15, 2020.
27. Moderna's mRNA vaccine reaches its final phase. Here's how it works. https://www.nationalgeographic.com/science/2020/05/moderna-coronavirus-vaccine-how-it-works-cvd/. Accessed August 15, 2020.
28. mRNA vaccines — a new era in vaccinology | Nature Reviews Drug . https://www.nature.com/articles/nrd.2017.243. Accessed August 15, 2020.