Review Article

A Comprehensive Review on COVID-19 (Corona virus) Pandemic – Challenges and Opportunities with Special Reference to Public Health Domain

[1]Aarti Arora*, [2]Archana Kumari, [3]Amarjit Kaur Arora, [4]Manoj Katual, [5]Amit Sharma, [6]Rajesh Kumar, [7]Gurkirandeep Kaur

[1.] Rayat-Bahra Institute of Pharmacy, Distt. Hoshiarpur, 146104, Punjab, India.
[2.] Assistant Professor, Department of Pharmaceutical chemistry, Rayat-Bahra Institute of Pharmacy, Hoshiarpur, Punjab, India; Research Scholar, Faculty of Pharmacy, I.K. Gujral Punjab Technical University, Jalandhar, India.
[3.] Associate professor, Department of Chemistry, Government College Derabassi, Punjab, India.
[4.] Associate Professor & HOD, Department of Pharmaceutics, Rayat-Bahra Institute of Pharmacy, Hoshiarpur, Punjab, India.
[5.] Associate Professor, Department of Pharmacology, Rayat-Bahra Institute of Pharmacy, Hoshiarpur, Punjab, India.
[6.] Assistant Professor, Department of Pharmaceutics, Lovely Professional University, Phagwara, Punjab, India.
[7.] Department of Agriculture, CSK Himachal Pradesh Agricultural University, Palampur, Himachal Pradesh, India.
***Corresponding author's E-mail:** archna689@gmail.com

Received: 12-06-2020; **Revised:** 24-08-2020; **Accepted:** 30-08-2020. **DOI:** 10.47583/ijpsrr.2020.v64i01.037

ABSTRACT

Corona virus disease 2019 (COVID-19), A new health crisis expanded all over the world is caused by the Severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). This highly contagious disease, as concluded from genome studies, originated in bats. In December 2019, it passed on to humans in Wuhan, Hubei province, China. After a few months, the infection was spread to about 109 countries. Total 113,702 confirmed cases globally and 4, 012 deaths were registered on March 10, 2020. On 11 March 2020, COVID-19 was declared a pandemic by WHO. The disease is transmitted by inhalation or contact with infected droplets having an incubation period range from 2 to 14 days. Fever, cough, sore throat, breathlessness, fatigue, malaise, etc. are some of the major symptoms of the disease. Diagnosis involves Reverse transcription-polymerase chain reaction from a nasopharyngeal swab or oropharyngeal swab, a chest computed tomography scan, and other collective symptoms. At present no vaccine, antiviral drug, therapy is documented, only preventive measures like hand washing, maintaining distance from other people, and not touching one's face, use of masks is recommended. In this critical situation, researchers are highly focused to combat this problem. This review article mainly emphasizes on the occurrence, causes, mode of action, updated statistical data, and preventive measures taken by the government for control of COVID-19.

Keywords: COVID-19, SARS-CoV-2, Corona virus), WHO, Pathogenic disease.

INTRODUCTION

More than a million children under the age of 5 die each year due to acute respiratory tract infections (ARTIs) which are also attributed to be a major reason for death among people of all age groups[1]. Corona viruses belong to the family of single-stranded RNA viruses and it causes infections in humans and animals and those infections range from respiratory, gastrointestinal, neurological diseases and hepatic diseases, etc. The various types of corona viruses from four different genera are alpha, beta, gamma, and delta-corona virus.Till date, seven strains of corona virus have been identified namely 229E (Alpha Corona virus), NL63 (Alpha Corona virus), OC43 (Beta Corona virus), HKU1 (Beta Corona virus), MERS-CoV(Beta corona virus which is the causative agent of Middle East Respiratory Syndrome- MERS), SARS-CoV (Beta corona virus which is responsible for causing severe acute respiratory syndrome- SARS), SARS-CoV-2 which is the causative agent of corona virus disease 2019 or popularly called as COVID-19[2].The new corona virus spread has seen an increasing trend especially in its emergence in humans and this can be attributed to the high prevalence, worldwide distribution, increased genetic diversity and more common recombination of the genetic sequences of the viruses and also, one more factor responsible for the increased spread is the increased human-animal interface activities.

Objective of the Study

This paper shall highlight the epidemiology, clinical symptoms, diagnosis and treatment, and preventions of this virus along with providing details of the history, origin of the disease, and the details of the virus.

History of spread of Corona Virus

It started in late December 2019 when many local health authorities reported the presence of an increased number of patients of pneumonia whose cause could not be diagnosed and were epidemiologically linked to the seafood consumption in the areas near to the Huanan seafood wholesale market near to Wuhan which is a city in the Hubei province of China. The identification of the pathogen SARS-CoV-2 was done using a surveillance mechanism for pneumonia of unknown etiology and it was based on the same principle as that of the 2003 SARS outbreak which aimed at the timely identification of the novel pathogens. It was on January 30, 2020, when the World Health Organization (WHO) declared COVID-19 a public health emergency of international concern and after that, the pandemic escalated rapidly and has now

spread to almost all the countries of the world which are facing it with varying degrees of severity and mortality rates[3].The spread initially began from Wuhan in China where people were diagnosed with an acute respiratory infection and this was linked to their consumption of seafood and it was declared as a global pandemic when clustered cases without a history to travel to Wuhan were seen and even in different foreign countries, similar cases have been reported which made it a global public health emergency. The statistics reported the number of infected people to reach to 80,302 as of March 2, 2020. The epidemics in Italy, Iran, and America and Spain have been the cause of major concern for the World Health Organization where the cases increased considerably. Quarantine and social distancing measures were an immediate response by the Hubei government to promote the containment of the spread of the disease.

Host and Reservoir of Corona Viruses

The disease is spread to be transmitted by wild animals and bats. Corona virus is a beta virus and hence major similarity in genetic sequence to SARS-CoV and it is thought to be most likely originated in bats and bats are said to be the most possible host of the virus but it still needs scientific evidence and confirmation. Other studies propose the snakes and minks as the possible reservoirs for human infection. Identification of two parental viruses of SARS-CoV 2 has been made in context to study the origin of SARS CoV-2 and COVID-19. The first one is bat corona virus RaTG13 found in Rhinolophus affinis from Yunnan Province and it has a good overall genome sequence identity with SARS CoV-2. The second one is a group of beta corona viruses which are found in species of small mammals like pangolins [4].

Mode of Transmission of the virus

The virus follows the person to person route of transmission and it is believed to be transmitted along a chain of 4 generations which includes the person who contacted the virus from non-human source and passes it to someone who in turn infects another individual, later who infects yet another individual. The respiratory droplet transmission is the confirmed main route of the transmission of this virus and it can be transmitted via the aerial droplets. Also, asymptomatic carriers may transmit the virus. Another mode of transmission which may be possible is the fecal-oral route wherein the viruses in the feces may be re-transmitted by the aerosol formation in the form of virus-containing droplets but as of now, no official confirmation or evidence for this is available and hence the established route of transmission for this disease is the respiratory droplet transmission[5].

Incubation period

The mean time from the onset of the development of symptoms to the hospitalization phase ranged between 2 and 8 days but the meantime from the manifestation of symptoms and the need for invasive mechanical ventilation (IMV) and to death is 11 and 23.7 days respectively.

Attachment and Fusion of the virus

1) The virus fuses with the membrane of the host cell; it is followed by the viral genome reaching the cytoplasm which then undergoes translation of accessory and structural proteins.

2) Formation of the newly generated envelope, nucleocapsid proteins, and genomic RNA occurs and the virus fuses to the cell membrane again in the form of virion containing vesicles that pinch out of the cell membrane and release the virus outside of the cell into the local microenvironment.

Structure of Corona virus

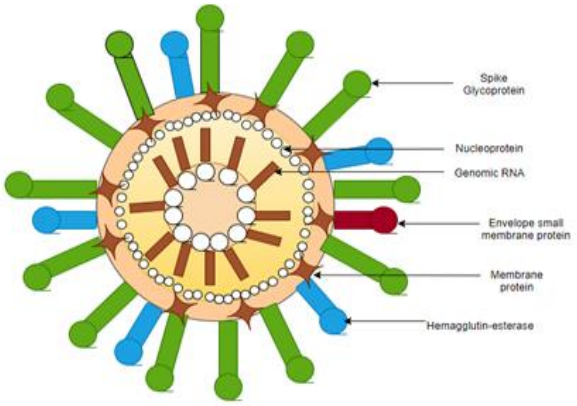

Figure 1: Structure of Corona virus

It is enveloped, positive-stranded RNA virus with nucleocapsid. The genomic structure is in the form of +ssRNA and it is around 30kb in length which makes it the largest known RNA virus having a 5'-cap structure and 3'-poly-A tail.The viral RNA causes the synthesis of polyprotein 1a/1ab in the host. During transcription, synthesis of subgenomic RNA sequences happens and it is possible due to the replication-transcription complex in the double-membrane vesicles. The open reading frames (ORFs) templates for the production of sub genomic mRNAs are the transcription regulatory sequences. The atypical CoV genome contains at least six ORFs and the frameshift between ORF1a and ORF1b help in the formation of pp1a and pp1ab polypeptides and the reaction is processed by virtually encoded chymotrypsin-like protease (3CLpro) and also by the papain-like proteases which help in the production of 16 nonstructural proteins (nsps).

The open reading frames (ORF) encode for structural proteins which include spikes, membrane, envelope and nucleocapsid proteins, and also the other components of the accessory protein chains. The pathophysiology and the virulence mechanisms of CoVs relate to the function of the nsps and structural proteins. nsp can block the host innate immune response. The envelope promotes the

assembly of the virus particles and its release. The spike of glycoproteins has the subunits S1 and S2 and these homotrimers of S protein which form the spike on the viral surface provides the site for attachment to the host receptors. The S2 subunit has a fusion peptide, transmembrane domain, and a cytoplasmic domain and it can be the target for anti-s2 or the antiviral compounds.

The viral infection is capable of producing excessive series of immune reactions in the host and generally, the underlying reaction involved is the cytokine form and it causes excessive tissue damage via dysfunctional coagulation. MicroCLOTS or the micro vascular COVID-19 lung vessels obstructive thrombo-inflammatory syndrome are the underlying causes for the lung viral injury and are related to inflammatory reactions and microvascular pulmonary thrombosis. The various cytokines which are present in the pathogenic cascade of the disease include tumor necrosis factor α (TNF-α), IL-1β, IL-8, IL-12, interferon-gamma inducible protein (IP10), macrophage inflammatory protein 1A (MIP1A), and monocyte chemo attractant protein 1 (MCP1), the major one is Interleukin 6 (IL-6) which is produced mostly by activated leukocytes and acts on many cells and tissues.

It helps in promoting the B lymphocyte differentiation and also promotes the growth of cells whereby inhibiting the growth of others and leads to increases in the production of acute-phase proteins. There has been evidence that toll-like receptor (TLR) helps in releasing IL 1β which further breaks to active mature IL 1β and mediates inflammation of lungs till the fibrosis stage is achieved. Histopathological data obtained from lungs show evidence of edema and proteinaceous exudates in the form of large protein globules. Some other features were vascular congestion along with inflammatory clusters of fibrinoid material and the hyperplasia of pneumocytes. The alveolar expression of the viral antigens is revealed via the diffuse alveolar injury which can be confirmed via immunostaining. Typical characteristics include capillary congestion, necrosis of pneumocytes, hyaline membrane, interstitial edema, and pneumocyte hyperplasia. Lung infiltrates revealed the presence of macrophages in the lumens of the alveoli and the presence of lymphocytes in the interstitial space [6].

Clinical Manifestations and the Associated Symptoms

The disease can be manifested with symptoms like mild, moderate, severe, or rapidly progressive and fulminant. It has nonspecific symptoms and can be presented at any age and can range from asymptomatic to extreme pneumonia and death.Fever, cough, myalgia (muscle pains), and fatigue are some of the most common/ typical symptoms of the disease. Atypical symptoms included sputum, headache, hemoptysis (coughing up of blood), and diarrhea. Most of the patients had dyspnea (difficulty in breathing) and lymphocytopenia. Pneumonia was the most common and prevalent symptom in all the patients. The complications of the disease included acute respiratory distress syndrome, acute heart injury, and secondary infections. It was generally observed that most of the infected patients had one or more underlying disease and comorbid conditions due to hypertension or chronic obstructive pulmonary disease, etc.

Effect of Corona virus on Excretory System

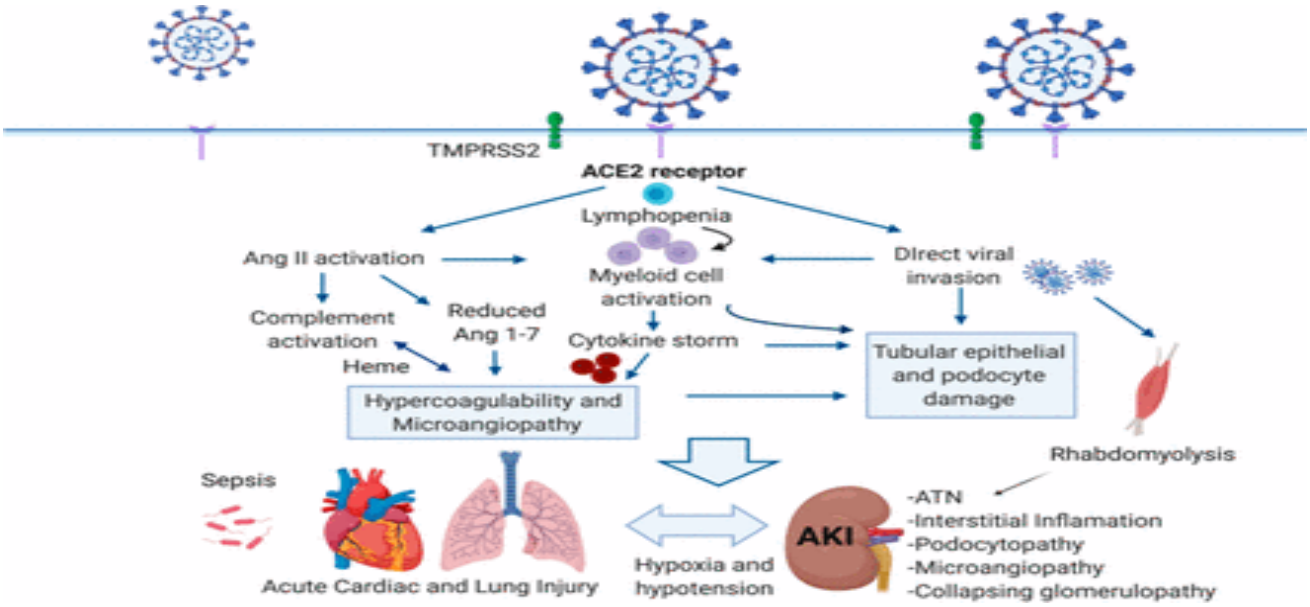

Figure 2: Targeting of ACE 2 by SARS-CoV-2[7].

ATN-acute tubular necrosis.

ACE2-angiotensin-converting enzyme 2 SARS-CoV-2 severe acute respiratory syndrome corona virus 2 TMPRSS2, transmembrane protease, serine 2.

Targeting of ACE2 by SARS-CoV-2 results in angiotensin dysregulation, activation of the innate and adaptive immune pathway, and hyper coagulation to result in organ injury and AKI associated with COVID-19. CD8+ T-

cells and natural killer cells are the potential targets for the corona virus and they can restrain macrophage activation. The renal manifestations of the disease are interstitial inflammation, podocytopathy, microangiopathy, and collapsing glomerulopathy[7].

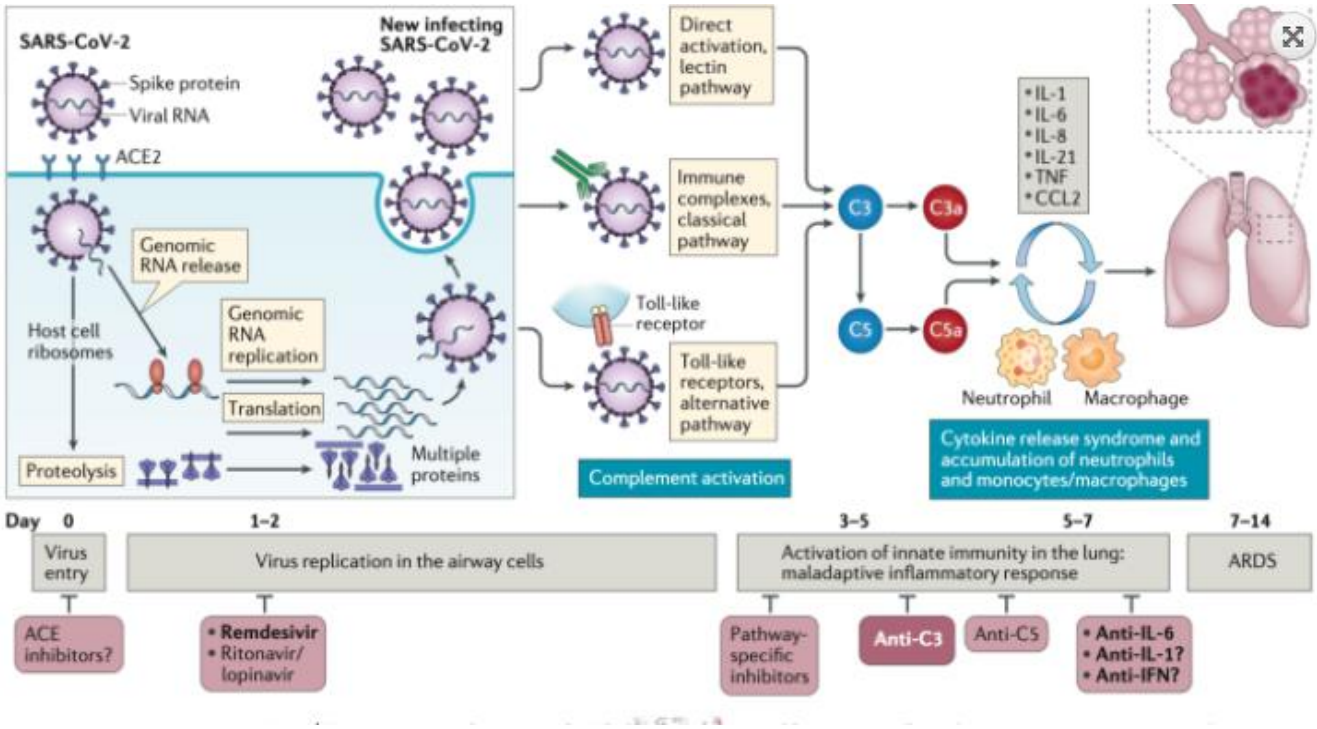

Figure 3: Pathogenesis of COVID 19[8]

Effect of Corona virus on the Nervous System

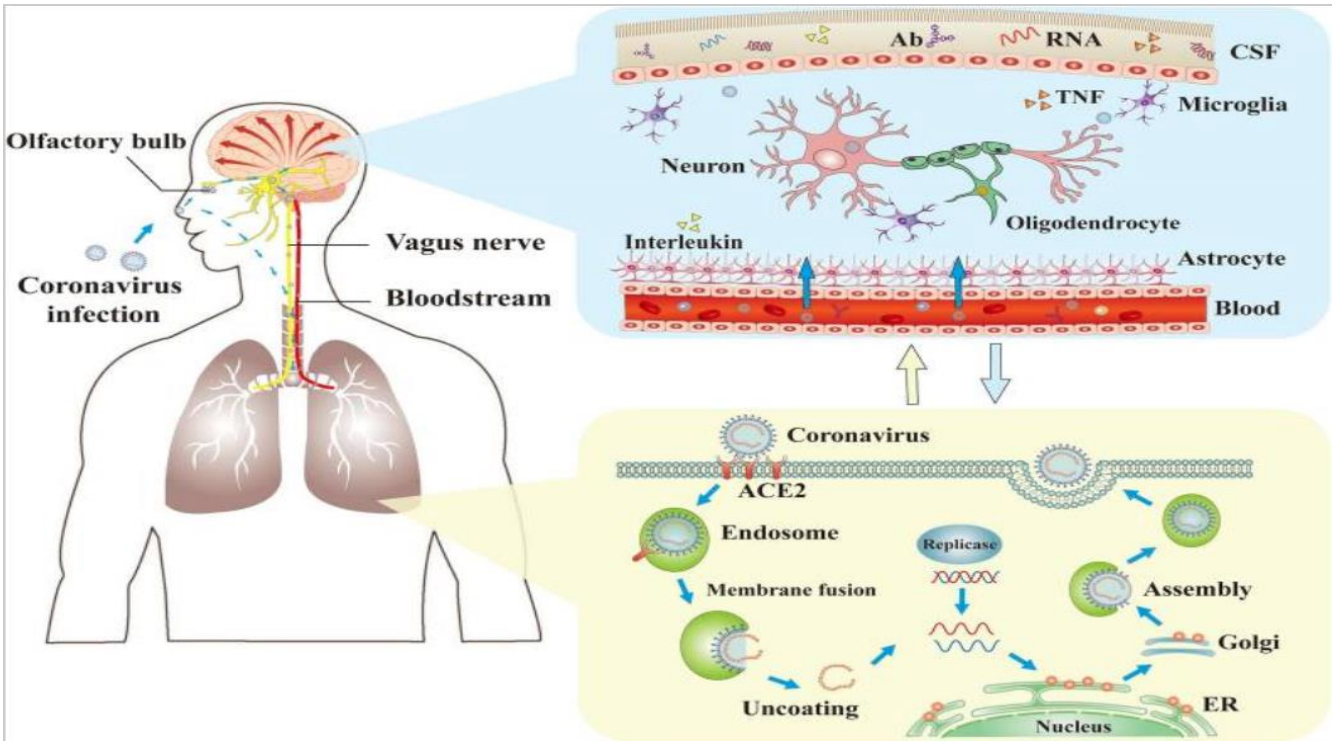

Figure 4: Neurological damage caused by coronaviruses[9].

Ab: antibody; ACE2: angiotensin-converting enzyme 2; CSF: cerebrospinal fluid; ER: endoplasmic reticulum; TNF: tumor necrosis factor.

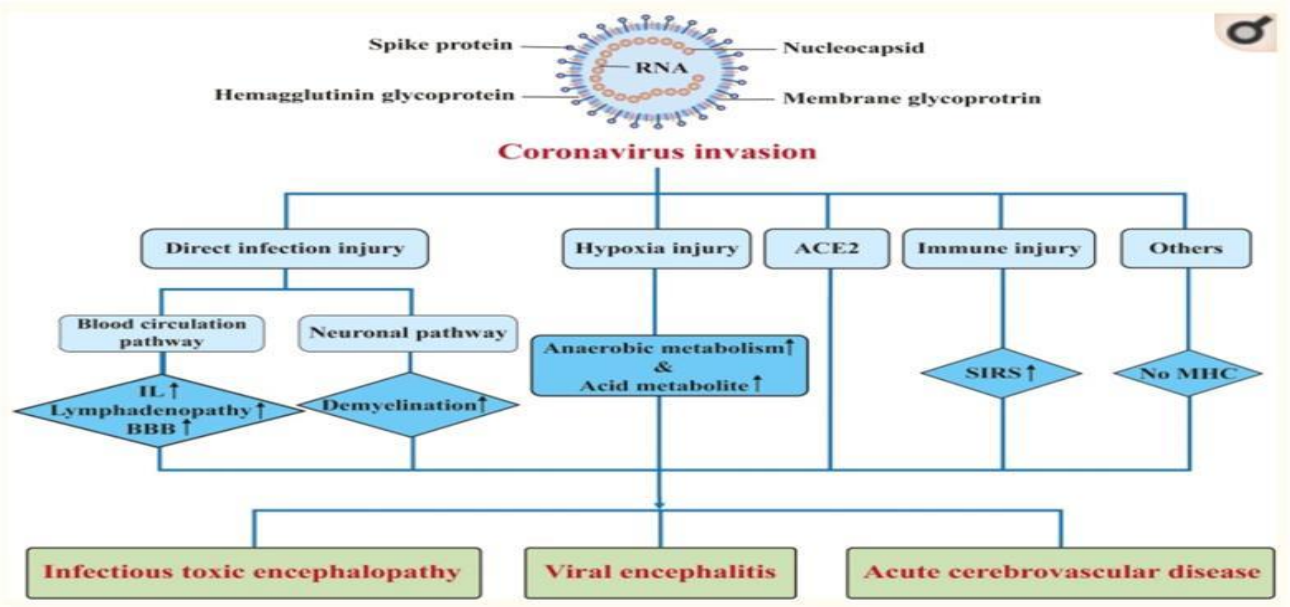

Figure 5: Pathogenesis of nervous system injury caused by CoV-2[9].

ACE2: angiotensin-converting enzyme 2; BBB: blood-brain barrier; IL: interleukin; MHC: major histocompatibility complexes; SIRS: systemic inflammatory response syndrome.

The Severe acute respiratory syndrome corona virus 2 (SARS-CoV2) infects the ACE2 which expresses on the epithelial cells in the lungs or the intestine and it produces mediators that further cause immune cell activation. Excessive activation of the immune cells can cause complications like acute respiratory distress syndrome, shock, kidney failure. There has been a presentation of more systematic symptoms and more severe radiological abnormalities in the elderly people of more than 60 years of age who are at maximum risk from the disease and children are less likely to become infected and they show mild symptoms or even be asymptomatic. The patients which included pregnant mothers and infants infected with the disease present the possibility of the virus being capable of crossing the placental barrier.

CoV2 can cause nerve damage by direction infection pathways (blood circulation pathways and neuronal pathways), hypoxia, immune injury, etc. The attack of the virus on the lung tissues causes lesions such as hypoxia and the virus to enter the nervous system through the olfactory nerve and also through direct infection pathways.

Effect of Coronavirus on Endocrine System

COVID-19 diagnosis includes the entrance of SARS-CoV-2 into the respiratory system and the parenchyma in the lungs. Thus, it uses angiotensin-converting enzyme 2 (ACE2) as an entry receptor to target pneumocytes. Additionally, the viral ribonucleic acid (RNA) was also found in COVID-19 patients' plasma or serum, suggestive of viremia. This means that the virus is freely available to communicate with ACE2 distributed in certain tissues aside from the pneumocytes. Indeed, ACE2 is produced by a variety of endocrine organs, including pancreas, thyroid, testis, ovaries, adrenal glands, and pituitary. However, there is no clinical/preclinical data as of yet. Here is what I found about how COVID 19 can affect the endocrine system based on research that has been examined:

- **Pancreas**: COVID-19 can cause insulin tolerance to worsen in patients with pre-existing type 2 diabetes mellitus (T2DM). In addition to producing a variety of cytokines, SARS-CoV-2 raises plasma amounts of fetuin-A, a glycoprotein related to compromised response to insulin. Lopinavir – ritonavir used for the treatment of COVID-19 may contribute to lipodystrophy and eventual insulin resistance.
- **Thyroid**: A research performed during the SARS epidemic in 2003 recorded lower serum T3 and T4 rates in patients with SARS relative to controls in both acute and convalescent phases. This may mean an underlying disease-euthyroid syndrome. Critical care patients with sick-euthyroid syndrome appear to have significantly lower thyroid weight due to the reduction of the follicular thyroid size.
- **Testis**: A recent study with 81 men with COVID-19 showed that total serum testosterone (T) was lower (although not statistically significant), however, the serum LH was slightly higher than 100 healthy men matched in age. In some COVID-19 patients the serum T: LH ratio was slightly smaller and negatively related to the frequency of the disease. Furthermore, it has been shown that SARS-COV decreases serum testosterone[10].

Diagnosis of the Disease

Clinical symptoms like fever, fatigue, dry cough, and dyspnea with or without nasal congestion, rhinitis or runny nose, and other symptoms related to the upper

respiratory tract are some common ones. Fever is the most typical symptom of the disease. Extreme infections in patients include symptoms such as shortness of breath, moist rales in lungs, weakened breath sounds, dullness in percussion, fluctuations in tactile speech tremors, etc.

The disease can be diagnosed by the following methods:

1) CT imaging examination: The computed tomography scan reveals findings which vary based on the age of the patient, immunity status, the stage of disease progression at the time of the scan, comorbid conditions and the intervention of drugs in case the person is on other medications for some other underlying disorder.

2) Chest X-ray examination: Chest images reveal the presence of multiple small patchy shadows and changes in the lung periphery and some cases with a severe infection also develop bilateral opacity, infiltrating shadows and pulmonary consolidation and pleural effusions which may be less common.

3) CHEST CT SCAN: The presence of pulmonary lesions is seen in the chest CT scan and also includes ground-glass opacity and segmental consideration in both the lungs especially in the periphery. In cases of children infected severely, multiple lobar lesions may be found in both the lungs.

4) Laboratory Identification of COVID 19:Laboratory analysis of this disease can also include findings related to fluctuations in the total number of leukocytes, decreased lymphocyte count, and changing several monocytes. It includes virus isolation and viral nucleic acid detection. Virus isolation is the gold standard for the diagnosis of the virus in the laboratory. Use of specimens such as swabs, nasal swabs from the nasopharynx region or the trachea, sputum, lung, blood, and feces is retained in a timely fashion and even virus nucleic acids may be used for early diagnosis.

5) The complete gene sequence of SARS-COV-2 is obtained and the samples obtained from the upper respiratory tract (like the oropharyngeal and the nasopharyngeal) and the lower respiratory tract (endotracheal aspirate, expectorated sputum, or bronchoalveolar lavage) are analyzed by real-time PCR method (polymerase chain reaction).

6) ELISA kits used for detecting IgM and IgG antibodies against N and other proteins are also available and it has made specific diagnoses possible[11].

Treatment and Preventions

As of now, no vaccine or antiviral treatment has been developed for the treatment of human and animal corona virus and it is the growing need of the hour that a vaccine should be developed and it needs adequate funding and public interest even if the risk involved with the disease reduces at some stage in the future. World Health Organization (WHO) has anticipated the development and availability of the vaccine in the market in 18 months. The treatment options for the infected patients as of now include the principles of symptomatic treatment and organ support is provided in the intensive care unit for extremely ill patients. The antiviral therapy drugs for COVID-19 may include remdesivir and clinical investigations can help prove the utility of drugs like ribavirin, protease inhibitors lopinavir and ritonavir, interferon α2b, interferon β, chloroquine phosphate, and Arbidol[12].

The general treatment strategies include bed rest, supportive treatment, prescribing antiviral or antimicrobial therapy to the infected patients, use of immunomodulators, provision of organ function, respiratory support, blood purification techniques are also being used and the extracorporeal membrane oxygenation is also used sometimes. The strategies which are adopted in all the nations to control the infection and its spread include controlling the source of infection (this is achieved by quarantine of the infected individuals), blocking the transmission route (this has been achieved by imposing strict lockdown in countries and the imposition of social distancing rules), adequate implementation of infection control measures and the screening of travelers at the airports for any signs and symptoms of the virus.

Favipiravir is one of the selected investigational drugs which acts by inhibiting RNA polymerase and hence restricts the replication of the virus. Also, it was found effective in influenza and Ebola virus and shows some response against the activity of RNA viruses[13]. For using Favipiravir for treatment of SARS-CoV2, it should be given in higher dose concentrations[14, 15]. The dosage recommended ranges from 2400 mg to 3000 mg and it should be administered two times a day and this has to be followed by a maintenance dose ranging from 1200-1800 mg every 12 hours and it has a half-life of almost 5 hours [16]. At low doses, the adverse effects of this drug are negligible and it is well tolerated at higher doses but shows minor adverse effects[17, 18].

Remdesivir which is also called GS-5734 shows a broad spectrum and for this reason, is a favorable choice of drug treatment for COVID-19. Its E50 and E90 values have been reported to be 0.77μM and 1.76μM respectively[19, 20]and it has been shown to have potent activity against different types of corona viruses including novel corona virus (SARS-CoV-2)[21].In the past observational examinations for the patients with SARS and MERS disease, corticosteroids had no relationship with the improved survival yet has a relationship with the delay in viral clearance from the respiratory tract and blood with many different complications like hyperglycemia, avascular necrosis, and psychosis[22, 23]. Since the use of corticosteroids is associated with some risks, these have not been used on a routine basis in patients with COVID-19.IL-6 antagonist namely Sarilumab is being used in

clinical trials of phases 2 and 3 for patients hospitalized with severe and moderate symptoms of COVID-19[24].

Recent clinical trials have been conducted for the mRNA-1273 vaccine which was found to induce immunogenicity. Quick and immense antibody responses were elicited to both full-length S-2P and receptor binding domain when vaccination was given for the first time based on time and dose-dependence. The vaccine for SARS-CoV-2 encodes a stabilized perfusion spike trimer which is referred to as S-2P. The surprising fact about this is that its production was finished in two months rather than the normal product development process time of many years. The manufacture and process of clinical trials were completed within 45 days[25]. Developing of vaccine for Covid-19 must record the correlations for fluctuations in Covid-19 recovering immunizer titers as indicated by different factors like age of the patient, degree of severity of the disease, time since the onset of disease, and for a total number of samples in the panel[26].

Statistical Data about COVID-19

As of June 2, 2020. the following data has been represented on the official website of the World Health Organization (WHO):

COVID 19 has affected 216 countries, areas, or territories.

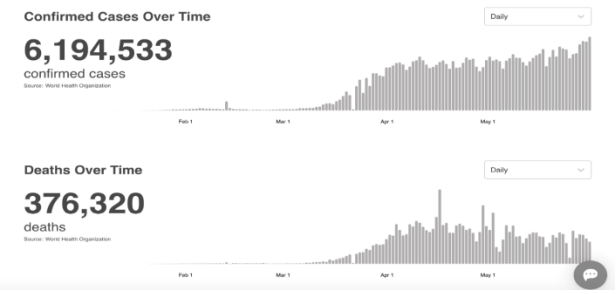

Figure 6: Worldwide confirmed cases and the deaths over time from COVID-19

World Health Organization (WHO)

Confirmed cases worldwide --6 194 533

Confirmed deaths worldwide --376 320

The worst-hit nation with the highest number of deaths with corona virus is America with the following statistical data:

Cumulative cases: 2,949,455

Cumulative deaths: 165,311

Cumulative recovered patients: 1,005,970

The worst-hit nation with the highest number of deaths with corona virus is America with the following statistical data:

Cumulative cases: 2,949,455

Cumulative deaths: 165,311

Cumulative recovered patients: 1,005,970

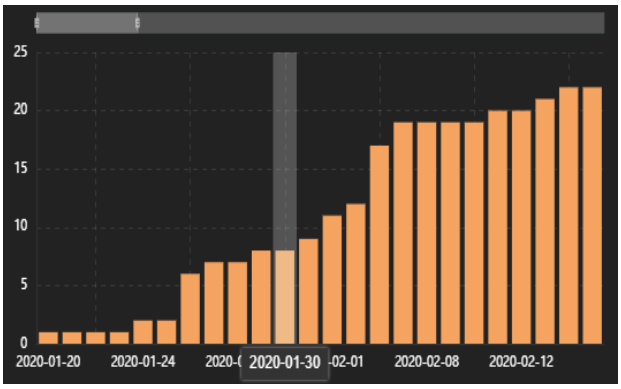

Figure 7: Corona virus cases statistics in America

CORONA VIRUS STATISTICS IN CANADA:

Confirmed cases -91351

Deaths over time---7305

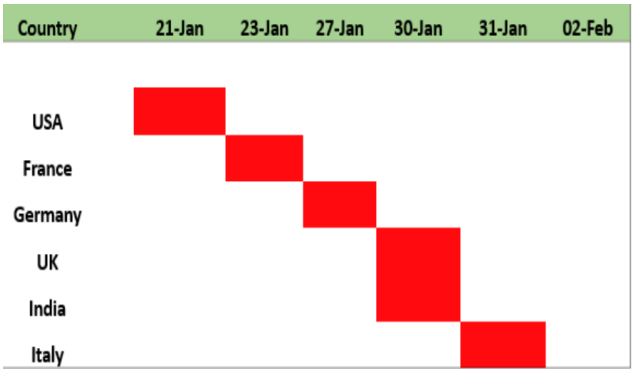

Figure 8: Date of first reported case[27].

As of 21 August 2020, the total number of confirmed cases of COVID-19 has reached 22,536,278, including 789,197 deaths, reported to WHO. The United States leads with the total number of confirmed cases 54,77,305 and it is followed by Brazil with a total number of 3,456,652 confirmed cases. India occupies the third position with 2,905,823 confirmed cases[28].

Action Plan of Corona virus

Objectives of the Action Plan

The plan adopted to reduce the transmission, spread of COVID-19 are as follows:

- Limiting of human to human transmission (quarantine for people with secondary infections or at risk of COVID-19 and adoption of effective social distancing measures)
- Identification, isolation, and provision of early care to the patients, optimized care for infected patients
- Identification and reduction of transmission from the animal source
- Addressing issues of clinical severity and monitoring the extent of transmission and infection
- The advocation of safe treatment options, increase in testing and diagnostics, therapeutics

- Communication of risk factors and event information to all communities and avoid misinformation

Various Solutions to achieve the objectives of the action plan

- Establishing international coordination between nations to deliver technical, operation support during a pandemic
- Increasing the preparedness and response operations of the nation and increasing diagnosis and identification of cases
- Increasing research and innovation and using methods to scale up research and development towards the development of vaccines and diagnostics
- Adopt a common method for standardization of processes, tools, and protocols and to promote integrated response-based research[29].

Various contingency plans to Mitigate the Challenges posed by the pandemic

- ✓ NATIONAL LABORATORY SYSTEM: The countries need to use a mechanism to test clinical samples of the suspected cases and the testing criteria adopted in all the nations should adopt a standardized procedure
- ✓ Methods should be devised to increase the national capacity for detection of the coronavirus and this, diagnostic testing needs to be performed quickly without the need for overseas shipping
- ✓ Collaborations should be made with National Influenza Centers to get more information about the detection of respiratory pathogens such as CoV-2
- ✓ World Health Organization should distribute adequate testing kits to laboratories in nations that suffer from a shortage of diagnostic testing methods due to the insufficiency of the testing kits.
- ✓ Various contingency plans and operational plans need to be effectively enforced at the points of entry of nations and it should assess the applicability of plan
- ✓ Testing for symptoms for the travelers should be done in an appropriate place and suspected cases should be offered quarantine facilities which shall include proper arrangements with on-site medical facilities which shall aim at facilitation of isolation, treatment, and provision of various support services like collection of samples and transport of samples to laboratories for testing.

Infection Prevention and Control

1) Proper training should be given to the hospital staff and personnel working in COVID wards and risk assessment should be done to check isolation capacity by checking the availability of ventilated isolation rooms and to test the healthcare system.
2) Hand hygiene resources, personal protective equipment, environmental cleaning, and sanitization strategies and adequate waste management protocols should be effectively implemented and followed.
3) It should be ensured to monitor, analyze the feedback of stakeholders and healthcare workers to look for adequate areas of improvement.
4) Global coordination between relevant stakeholders should be ensured to meet the face of a global crisis and coordination from the Research and development sector, academics, industry to governments and non-governmental associations should be must to tackle the global pandemic.
5) Emphasis should be made on the promotion of clear and transparent global research and innovation policies that shall adequately respond to the nation's needs and reduce barriers for future research.
6) Harmonization needs to be there and this can be achieved by building common platforms for clinical trials, specimen sharing, and sharing of data during outbreaks and common standardized protocols should be adopted for sampling, storage, shipment, transport, and data entry[29].

CONCLUSION

In the present day, not much is scientifically known about COVID 19 but, surely, this is a highly infectious human pathogen and more likely a zoonotic agent. The pressing need of time today is that countries need to take stringent steps to prevent the spread of the disease and hence, in turn, save the lives of the people. There is an urgent need for ELISA reagents for the detection of SARS-CoV-2 antigens such as S and N and will make the possibility of using another test highly complementary to viral RNA detection. There are a lot of questions which still need to be answered like the cases who tested positive and got cured, can they still transmit the disease to others? Such unanswered questions set a strong basis for future research and exploration about this topic and as of now, more detailed criteria for prevention and control of the disease can be adopted and better treatment methodologies can be adopted. Further research needs to be made owing to the considerable uncertainty surrounding the extent of origin of the outbreak within China, the spread of the virus and the clinical spectrum of the disease and hence there is a need to update the gaps in our knowledge of the disease regularly based on research and development.

Acknowledgement: The authors of this paper are highly indebted to all the faculty members of RayatBahra Institute of Pharmacy, Hoshiarpur, and Punjab for their encouragement and constant support which has immensely helped us in completing this article. The authors hereby declare no conflict of interest.

REFERENCES

1. Black, R. E., Cousens, S., Johnson, H. L., Lawn, J. E., Rudan, I., Bassani, D. G., C. (2010). Global, regional, and national causes of child mortality in 2008: A systematic analysis. Retrieved August 23, 2020, from https://pubmed.ncbi.nlm.nih.gov/20466419/
2. Coronavirus. (2020, February 15). Retrieved August 23, 2020, from https://www.cdc.gov/coronavirus/types.html
3. Wu1, D., Wu2, T., Liu1, Q., & Yang, Z. The SARS-CoV-2 outbreak: What we know. International Society for Infectious Diseases, 94, 2020, 44–48.
4. Yuen, K. S., Ye, Z. -W., Fung, S. Y., Chan, C. P., & Jin, D. Y. (2020). SARS-CoV-2 and COVID-19: The most important research questions. Cell & Bioscience, 10. Retrieved from https://cellandbioscience.biomedcentral.com/articles/10.1186/s13578-020-00404-4
5. Modes of transmission of the virus causing COVID-19: Implications for IPC precaution recommendations. (2020, March). Retrieved August 23, 2020, from https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations
6. Cascella, M., Rajnik, M., Cuomo, A., Dulebohn, S., & Napoli, R. D. (2020). Features, Evaluation, and Treatment Coronavirus (COVID-19). Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK554776/
7. Batlle, D., Soler, M. J., Sparks, M. A., Hiremath, S., South, A. M., Welling, P. A., & Swaminathan, S. (2020). Acute Kidney Injury in COVID-19: Emerging Evidence of a Distinct Pathophysiology. Journal of the American Society of Nephrology. DOI: 10.1681/asn.2020040419
8. Risitano, A., Mastellos, D., Huber-Lang, M., Yancopoulou, D., Garlanda, C., Ciceri, F., &Lambris, J. (2020, April 23). Complement as a target in COVID-19? Retrieved September 05, 2020, from https://www.nature.com/articles/s41577-020-0320-7
9. Wu, Y., Xu, 1 X., Chen, Z., Duan, J., Hashimoto, K., Yang, L., … Yanga, C. (2020). Nervous system involvement after infection with COVID-19 and other corona viruses. Brain Behav Immun. DOI: 10.1016/j.bbi.2020.03.031
10. Pal, R., & Banerjee, M. (2020). COVID-19 and the endocrine system: exploring the unexplored. J Endocrinol Invest 1–5. DOI: 10.1007/s40618-020-01276-8
11. Zhai, P., Ding, Y., Wu, X., Long, J., Zhong, Y., & Li, Y. The epidemiology, diagnosis, and treatment of COVID-19. Retrieved August 23, 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7138178/
12. Stewart, J. COVID-19: Prevention & Investigational Treatments. Retrieved August 23, 2020, from https://www.drugs.com/condition/covid-19.html
13. Shiraki, K., &Daikoku, T. Favipiravir, an anti-influenza drug against life-threatening RNA virus infections. Pharmacology & Therapeutics, 209, 2020, 107512. DOI: 10.1016/j.pharmthera.2020.107512
14. Chinello, P., Petrosillo, N., Pittalis, S., Biava, G., Ippolito, G., &Nicastri, E. (2017). QTc interval prolongation during favipiravir therapy in an Ebolavirus-infected patient. PLOS Neglected Tropical Diseases, 11(12). DOI: 10.1371/journal.pntd.0006034
15. Kumagai, Y., Murakawa, Y., Hasunuma, T., Aso, M., Yuji, W., Sakurai, T., Kaneko, A. Lack of effect of favipiravir, a novel antiviral agent, on QT interval in healthy Japanese adults. Int. Journal of Clinical Pharmacology and Therapeutics, 53(10), 2015, 866-874. DOI:10.5414/cp202388
16. Chen, C., Zhang, Y., Huang, J., Yin, P., Cheng, Z., Wu, J., Wang, X. (2020). Favipiravir versus Arbidol for COVID-19: A Randomized Clinical Trial. DOI:10.1101/2020.03.17.20037432
17. Siegel D, Hui HC, Doerffler E, et al. Discovery and synthesis of a phosphoramidate prodrug of a pyrrolo[2,1-f] [triazin-4-amino] adenine C-nucleoside (GS-5734) for the treatment of Ebola and emerging viruses. J Med Chem. 60(5), 2017, 1648-1661.
18. Al-Tawfiq, J. A., Al-Homoud, A. H., & Memish, Z. A. Remdesivir as a possible therapeutic option for the COVID-19. Travel Medicine and Infectious Disease, 34, 2020, 101615. DOI: 10.1016/j.tmaid.2020.101615
19. Ebola | WHO R&D Blueprint – Ad-hoc Expert Consultation on clinical trials for Ebola Therapeutics. (2019, March 26). Retrieved August 23, 2020, from https://www.who.int/ebola/drc-2018/treatments-approved-for-compassionate-use-update/en/
20. Jacobs M; Rodger A; Bell DJ, et al. (2018). Late Ebola virus relapse causing meningoencephalitis: A case report. 388(10043):498-503. Retrieved August 23, 2020, from https://pubmed.ncbi.nlm.nih.gov/27209148/
21. Holshue, M. L., Debolt, C., Lindquist, S., Lofy, K. H., Wiesman, J., Bruce, H., Pillai, S. K. First Case of 2019 Novel Coronavirus in the United States. New England Journal of Medicine, 382(10), 2020, 929-936. DOI:10.1056/nejmoa2001191
22. Morra, M. E., Van Thanh, L., Kamel, M. G., Clinical outcomes of current medical approaches for the Middle East respiratory syndrome: A systematic review and meta-analysis. Reviews in medical virology, 28(3), 2018, e1977. https://doi.org/10.1002/rmv.1977
23. Wang, D., Hu, B., Hu, C., Zhu, F., Liu, X., Zhang, J., Peng, Z. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. Jama, 323(11), 2020, 1061. DOI:10.1001/jama.2020.1585
24. Soo, Y., Cheng, Y., Wong, R., Hui, D., Lee, C., Tsang, K., Sung, J. Retrospective comparison of convalescent plasma with continuing high-dose methylprednisolone treatment in SARS patients. Clinical Microbiology and Infection, 10(7), 2004, 676-678. DOI:10.1111/j.1469-0691.2004. 00956.x
25. Jackson, L., Al., E., Group, F., Author Affiliations from Kaiser Permanente Washington Health Research Institute (L.A.J.) and the Center for Global Infectious Disease Research (CGIDR), Heaton, P., D. R. Boulware, and Others, & J. H. Beigel and Others. (2020, July 14). An mRNA Vaccine against SARS-CoV-2 - Preliminary Report: NEJM. Retrieved August 23, 2020, from https://www.nejm.org/doi/full/10.1056/NEJMoa2022483?query=featured_coronavirus
26. Wang, X., Guo, X., Xin, Q., Pan, Y., Li, J., Chu, Y., Wang, Q. (2020, January 01). Neutralizing Antibodies Responses to SARS-CoV-2 in COVID-19 Inpatients and Convalescent Patients. Retrieved from www.medrxiv.org/content/10.1101/2020.04.15.20065623v3
27. Kant, A., Mothkoor, V., & Sinha, S. (n.d.). COVID-19: Trends in India and the World. Retrieved from https://niti.gov.in/sites/default/files/2020-04/COVID-19-Trends-in-India-and-the-World.pdf
28. WHO Coronavirus Disease (COVID-19) Dashboard. Retrieved August 22, 2020, from https://covid19.who.int/?gclid=Cj0KCQjw4f35BRDBARIsAPePBHx6ZgSGRgcZB0bJZ5GmtvFjFlJTOMnZIFbGqq4FmwHQn29tCK23fSkaAn0tEALw_wcB
29. World Health Organization. (2020). Novel Coronavirus (2019-nCoV): Strategic Preparedness and Response Plan (pp 1-23). Geneva, Switzerland. Retrieved from https://www.who.int/docs/default-source/coronaviruse/srp-04022020.pdf

Source of Support: None declared.

Conflict of Interest: None declared.