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(REVIEW ARTICLE)

COVID-19 (SARS-COV-2) structural features, pathophysiology and current drug therapy

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Abstract

The 2019 coronavirus pandemic disease has spread globally. SARS-CoV-2 species in the first and second time waves and new species of Omicron show symptoms in the third wave of COVID-19 worldwide. The first patients were found in Wuhan, China. Due to COVID-19, the main highly infected countries are the U.S. China, European countries, and also India. The SARS-CoV-2 species are betacoronavirus infections that spread from person to person and another object. The COVID-19 SARS species (RNA virus) is majorly infected in the lungs. Some vaccines and some drugs are provided worldwide, but these vaccines are not proper treatment for COVID-19. These vaccines boost immunity and provide relief from the symptoms of COVID-19, but they are not a proper treatment. Antimalarial drugs, antiviral drugs, monoclonal antibodies, and antibiotics are used in the current treatment to stop mechanisms like fusion entry and replication. Identification of COVID-19 through symptoms and properly identified by RT-PCR Prevention and treatment of COVID-19 disease is a promising new research area for pharma companies to develop novel therapeutic agents' inhibition for COVID-19 pathological targets.

Keywords: Diagnosis of COVID-19; Pathophysiology; Drug therapy; S protein; Replication

1. Introduction

Coronavirus disease is a pandemic disease that infects humans. Coronavirus is a type of RNA virus that produces club-like spike proteins on its surface and has a unique replicating process (Abdul et al., 2020). A serious acute respiratory infection shows up in diseases. SARS-CoV-2 infection through severe pneumonia was reported in the market for seafood in Wuhan, China (Wang et al., 2020), and the disease is called COVID-19 (Letko et al., 2020). COVID primarily infected the respiratory system. Coronaviruses can spread infections to people worldwide. The appearance of SARS-CoV-2 in mainly human lung cells can cause COVID-19 diseases, which are highly spread through contact between people via respiratory droplets that cause coughing and sneezing. Symptoms are shown in a period of two to 14 days. Coronavirus is transmittable and spread by touching the eyes, nose, and mouth. These people catch COVID-19 and also the person-to-person contact to transmission, which was identified and attributed to the community spread of COVID-19. It has been reported in approximately 200 countries around the globe. Symptoms like cough, sneezing, fever, and breathing problems can create problems like pneumonia, pain in the throat, and also respiratory syndrome problems (Shereen et al., 2020). Respiratory tract infections are caused by the common cold and some other diseases such as SARS and also the newly discovered coronavirus (COVID-19) disease. Some factors are important in the COVID-19 death rate, like age,

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where the rate of death was ten times higher in aged people than in middle-aged people and the lowest at age under 30. People's health issues to the patient's chances of increasing death. The patients are suffering from diabetes, high B.P. problems, and heart and breathing or respiration problems. A new health crisis has spread throughout the world as a result of COVID-19. The corona disease outbreak has been declared a public health emergency worldwide by the WHO. They estimated the infection mortality rate at 0.4 to 1.4%. Some patients already suffering from other diseases are CVS disease, diabetes, asthma, and chronic pulmonary disease patients, following orders of 10.5%, 7.3%, and 6.3% (Abdul et al., 2020).

2. Coronavirus-2 (SARS-CoV-2)

Corona species SARS-CoV-2 betacoronavirus genus (Letko et al., 2020).These species are encoded by structural proteins and non-structural proteins. These species have trimeric spike proteins that interact with the host enzyme ACE-2 to fuse with the cell membrane and gain access to cells (Ou et al., 2020). Structural proteins contain proteins that are spikes, envelope, membrane, and nucleocapsids (N) and nonstructural proteins such as 3-chymotrypsin, protease, as well as papain dependent protease, and others like RNA-dependent RNA polymerase (Chan et al., 2020). The SARS-CoV-2 pathogen virus is encased in a single-stranded RNA envelope (Lu et al., 2020).

2.1. Structure of Spike Protein

SARS-CoV-2 has trimeric spike proteins that are shown in a bulbous, crown-like arrangement around the virus particles(Huang et al., 2020). Spikes present on the surface of the coronavirus are involved in infections(Pan et al., 2020). Spikes are trimeric glycoproteins that help with viral particle entry. Spike-like protein sizes are 180–200 kDa. The spike protein contains an intracellular C-terminal segment, an extracellular N-terminal segment, and transmembrane domains in the viral membrane (Bosch et al., 2003). Spike proteins exist in a metastable state and are rearranged in the virus to fusion through the predominantly host cell membrane (Watanabe et al., 2020). Spikes are proteins that have been coated with carbohydrates, primarily polysaccharides. Cellular proteases cut spike protein in the S1, S2 unit's serine protease TMPRSS2 so that it can be used as a protein primer.S1 functions are receptor-binding studies, and S2 functions are membrane fusion. The S1 consists of 14–685 residue regions; the N-terminal part consists of 14–305 residues, and the receptor-binding part or region consists of 319–541 residual parts. (Xia et al., 2020) says that the interaction between viruses on cell membranes and the host membrane helps start infections in targets, which is a key part of virus entry and a good sign for disease targets. The receptor binding region consists of a core sub-domain and a receptor interaction motif that directs binding with ACE2. The receptor interaction domain presented in S1 interacted with ACE2 in the part of aminopeptidase N. Spike protein binding to the host cell membrane and induced viral cell membrane fusion are important in the process of viral invasion. Mutations play a significant role. The receptor BD region (Walls et al., 2020) is a promising target for inhibitory action against COVID-19 infection disease(Hoffmann et al., 2020). The S2 subunit consists of 686–1273 residues, which forms a fusion peptide formed by 788–806 residual parts; the heptapeptide repeat sequence (HR1) consists of 912–984 residual parts, and HR2 also consists of 1163–1213 parts; the TM domain consists of 1213–1237 residual parts; as well as the cytoplasm domain consists of 1237–1273 residual parts, which is responsible for the mechanism of virus fusion as well as entry. A fusion peptide plays a key role in mediating membrane or target fusion by disturbing and also connecting the lipid bilayer of host membranes or receptors. Heptapeptide repeat sequences 1 & 2 are composed in a repeated manner of heptapeptide HPPHCPC (H acts as a lipophilic or chain, P is the hydrophilic or polar group, and C is another charged residue group). Heptapeptide repeat sequence-1 and 2 form a six-helical bundle and have a very promising role in showing viral fusion as well as entry into the S2 region. HR1 is present at the C-terminal of a lipophilic fusion. HR2 is a peptide that is mostly found at the N-terminus of the TM parts (Huang et al., 2020). Heptapeptide repeat sequence is a homotrimeric with three highly conserved nonpolar grooves. The HR1 region is bound by heptapeptide repeat sequence-2 in a rigid helical and flexible conformation (Xia et al., 2020; Chambers et al., 1990).

2.2. Pathophysiology

SARS-CoV-2 responds to coronavirus infections. SARS-CoV-2 through inhalation of respiratory aerosols present in nasal epithelial cells in the upper part of the respiratory tract. Covid goes through the replication and propagation process and infection by ciliated cells in the airways. due to the disease with symptoms like fever and dry cough. Coronavirus infiltrates and enters alveolar epithelial cells via ACE-2, where it replicates and produces more viral nucleocapsids. Glycosylation on S proteins on the surface of COVID-19 species shows binding with the host cell membrane ACE-2 for virus cell entry. The TM protease serine-2 protease is primarily found in the host cell membrane, where it promotes virus entry by activating Spike proteins (Hoffmann et al., 2020).SARS-CoV-2 virus permeability in cells to viral RNA releases polyproteins for genome translation, replication, as well as and transcription. In the viral ribonucleic acid genome, protein cleavages and assembly of replica and transcriptase complex enzymes. Replication in SARS-CoV-2 species to synthesize and assemble structural features of proteins and pack them in host cells after viral particles are

released. Spike protein is highly stored by human coronaviruses and helps in receptor identification, virus attachment, and entry of virus particles into host cells. Host cells of viruses undergo the apoptosis process and release other new viral particles from infected alveolar cells (Mason et al., 2020). Virus replication causes type 1-2 pneumocyte loss and increases the risk of acute respiratory distress syndrome (ARDS) (Wu et al., 2020).

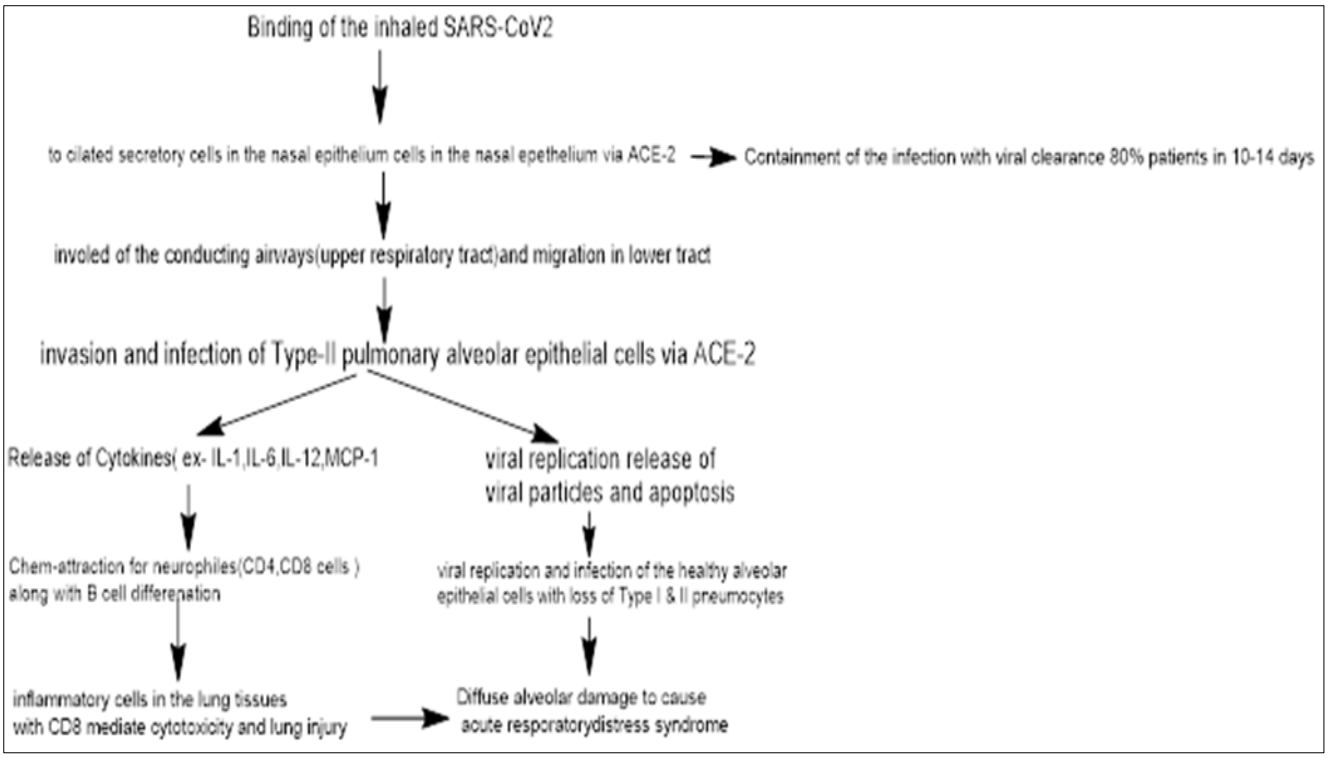

Figure 1 Pathophysiology of species SARS-CoV-2 (Mason et al., 2020; Wu et al., 2020)

2.2.1. Some requirements followed by yourself

- Every time you wash your hands properly with soap and hot water and also hand sanitiser,
- Maintain social distance,
- Avoid mass gatherings,
- Use face masks without masks, do not go outside, and Vaccination of all people. Vaccines also boost our immunity (WHO,2020).

2.2.2. Some requirements followed by others

Some requirements are as follows: a. Staying at home if you are feeling unwell and have symptoms such as cough, fever, or breathing problems; b. Use face masks and washing your hands through soap and water as well as a sanitizer; c. if you are not well to stay and isolated in a separate room from the family; d. if possible, use individual bathrooms from the family; e. Avoid direct physical contact. (Abdul et al., 2020).

Current drug therapy used against SARS-CoV-2 and omicron treatment

(Tu et al., 2020; Agostini et al., 2018; Chu et al., 2004).

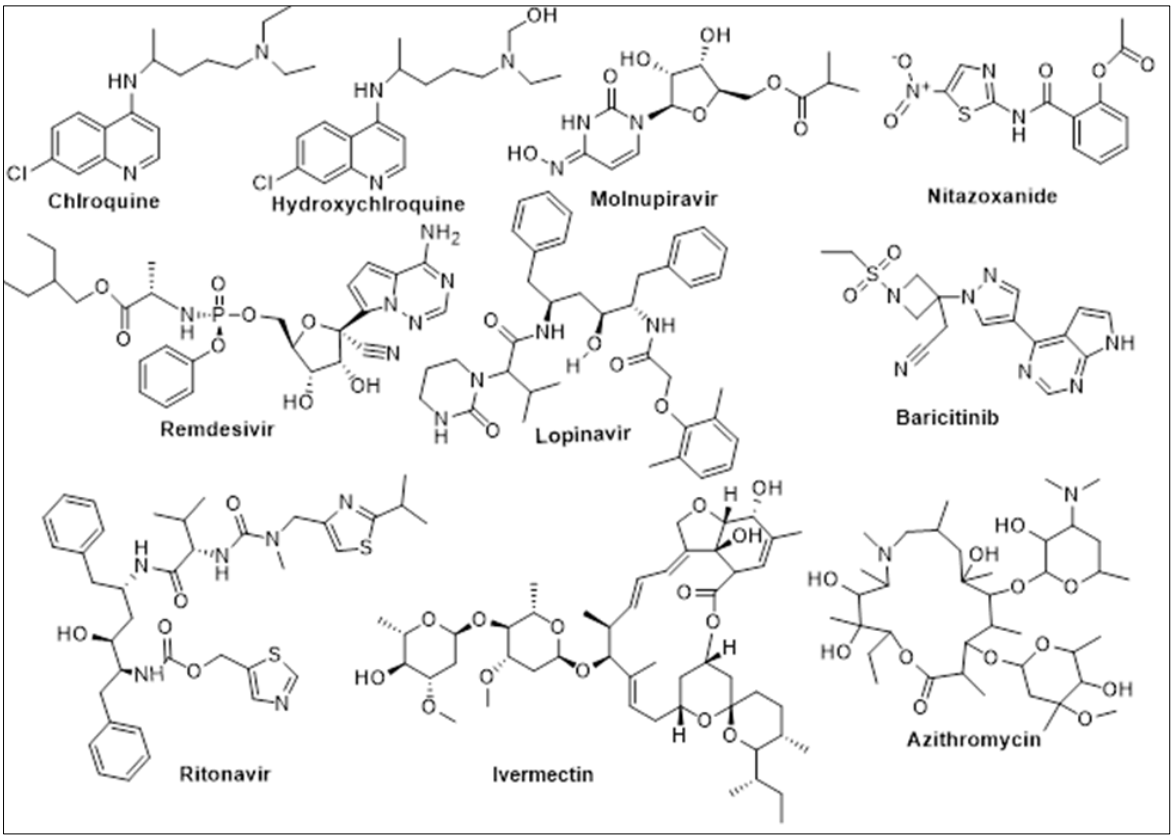

Figure 2 Drug Structures to Treat COVID-19 Infection

Current drugs used against COVID-19 and also available vaccines in the market are Covaxin (Bharat Biotech), Covishield vaccine (AstraZeneca) and serum institute Tozinameran (Pfizer vaccine) (Rawat et al., 2021)

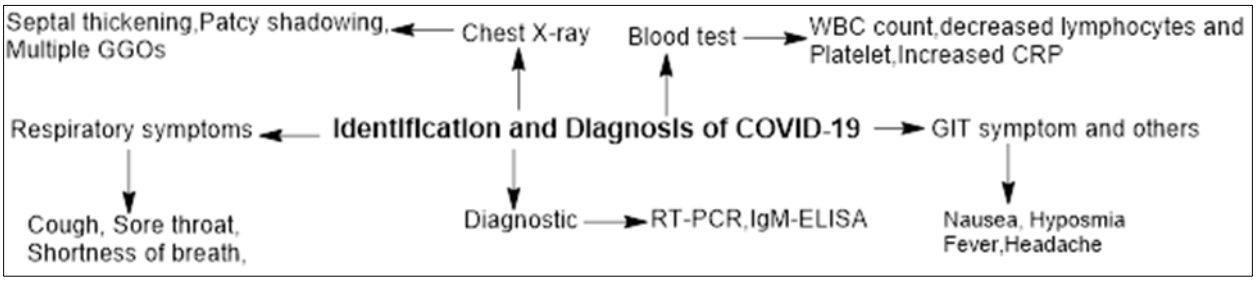

Figure 3 Identification and Diagnosis of COVID-19 (Tu*et al.,* 2020)

3. Conclusion

The review article helps to provide knowledge on how to spread coronaviruses, SARS-CoV-2 species infections in populations, structural features of SARS species, and current drug therapy in marketed drugs and some vaccines to help against SARS-CoV-2 and omicron infections. Current drugs and vaccines to aid in the inhibition of various covid species mechanisms vaccines also show effective treatment against COVID-19 species.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors' declarations do not have any type of conflict of interest.

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