Recent discovery and development on SARS-CoV-2: A review of current literature

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Abstract

The origin and spread of current novel coronavirus had raised serious concerns among stakeholders around the globe. Different speculations that may unfold the mystery in the future are taking roots, but now there is no globally acceptable opinion about the origin and spread of this novel coronavirus. It is reported that Wuhan city of Hubei Province of central China was the epicenter of this outbreak of novel coronavirus. However, initial inadequate preventive measures allowed the infection to cross the borders of China and that pulls the world into drastic public health and economic crisis. This coronavirus disease now named as COVID-19 by World Health Organization (WHO) and the responsible coronavirus is named as "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)." The spread of SARS-CoV-2 is alarming even after 5 months of inception and WHO further warns the world to be prepared for more intense spread of COVID-19. Different diagnostic tools to detect SARS-CoV-2 are being used around the globe, but the identification of asymptomatic carriers of the disease is a serious challenge in countering the COVID-19 pandemic. There is no specific treatment available, only preventive, symptomatic, and supportive treatments are being used for clinical management of COVID-19. The available knowledge is limited, therefore, any escalation of information on the disease will help to combat this global challenge of COVID-19. In this review, we have discussed and summarized the available multi-factorial information and recent updates on the SARS-CoV-2 which can help support future research and may help in the strategic management of the current COVID-19 pandemic. The articles available online before June 30, 2020, on bioRxiv, medRxiv, ChemRxiv, Google Scholar, and PubMed have been assessed for the compilation of this review. Information on the official portal of WHO, CDC, ICMR, etc., were also assessed and used with due credit.

Keywords: Coronavirus, COVID-19, pandemic, public health, SARS-CoV-2

Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2)

A cluster of patients with pneumonia of unknown reasons were reported in Wuhan, Hubei Province, China in December 2019 and later a novel coronavirus had been identified as the cause of this outbreak of this illness.[1] World Health Organization (WHO) named this coronavirus disease as "COVID-19" on February 11, 2020 and declared this outbreak, a pandemic on March 11, 2020.[2] The novel coronavirus responsible for COVID-19 is named as "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)" by the Coronaviridae Study Group (CSG) of the International Committee on Taxonomy of Viruses, ICTV.[3] Within a few weeks of origin, the SARS-CoV-2 had spread rapidly from China to other countries including Italy, Spain, France, Germany, Iran, United States, Brazil, Britain, India, etc., The rapid spread of ongoing COVID-19 indicated that the SARS-CoV-2 is highly communicable affecting the whole world. There are different conjectures among global stakeholders about the origin and spread of this killing SARS-CoV-2. These assumptions pondered upon giving facts and highlighted the

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need for in-depth investigations to answer the raised questions. Although WHO and the Chinese Government both officially rejected any kind of rumors.

SARS-CoV-2 caused highly infectious pneumonia with mild, moderate, or severe illness.[1] In the past two decades, two other coronaviruses (CoVs) also caused epidemics which were SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV). SARS-CoV-2 belongs to the same beta coronavirus subgroup that contains SARS-CoV and MARS-CoV.[4] SARS-CoV-2 is a new virus and the body does not know how to fight this unknown virus. Understanding of SARS-CoV-2 transmission, survival, the effect of infection on various organs, and the knowledge of the overall health impact of this virus are still in infancy which makes the treatment and management of COVID-19 challenging. Available information supported that the SARS-CoV-2 can be transmitted person-to-person with high potential, intensity, and rapid rate. The spread of SARS-CoV-2 is at an alarming rate which is increasing day by day in the different parts of the world at a rapid pace. Till date (June 30, 2020), over 10.0 million cases and 0.5 million deaths by SARS-CoV-2 infection are reported worldwide which is demanding a fast development of efficient prevention and treatment strategies to deal with this viral infection.

There is no specific treatment available to neutralize SARS-CoV-2 infection which is making the prevention and management of COVID-19 challenging. More than 300 active randomized clinical trials (RCTs) are ongoing in the world on potential therapy to treat SARS-CoV-2 infection but so far no RCT showed improvement in outcomes[5] (Sanders *et al.* 2020). In the current alarming situation, the whole world is mainly depending upon social distancing, isolation, quarantine, and lockdowns which have been found the most effective strategies so far to combat this global challenge of COVID-19. These strategic actions have already proven the effect in the countries and territories where these measures have been executed timely, imposed efficiently, and followed adequately. Since limited preliminary information is available through literature and experiments on SARS-CoV-2 and COVID-19, therefore, any adding up on the topic will help in the prevention and management of this COVID-19 pandemic. In this article, we have summarized and discussed the available multi-factorial information on the SARS-CoV-2 and COVID-19 which can support future research and may help in strategic management of this global health emergency. COVID-19 is a new disease that is affecting the whole world at an alarming pace, therefore, this multi-factorial, updated and summarized information on SARS-CoV-2 and COVID-19 will help primary care physicians, specialized clinicians, and researchers in the screening, diagnosis, and management of SARS-CoV-2 infection.

Figure 1: Schematic representation of balancing between disease burden and control measures

Origin and History of Coronaviruses

CoVs affect the respiratory tracts of birds and mammals including humans. The name "coronavirus" is derived from the Latin word "corona" which means crown. The surface projections on the viral envelope give the virus an appearance similar to a crown. In 1937, a coronavirus was isolated for the first time, and currently, 39 species of CoVs are reported in 27 subgenera, five genera, and two subfamilies of family Coronaviridae, suborder Cornidovirineae, and order Nidovirales.[6] CoVs have been defined as a respiratory tract virus in 1962 collected from the symptomatic individual of respiratory tract infection.[7] Currently, seven types of humans coronavirus (HCoVs) have been reported as follows: (i) Alpha coronavirus -229E, (ii) Alpha-coronavirus -NL63, (iii) Beta-Coronavirus - OC43, (iv) Beta-coronavirus -HKU1, (v) SARS-CoV, MERS-CoV, (vi) and SARS-CoV-2.[3,8]

Figure 2: Schematic representation of the taxonomy of Coronaviridae as per ICTV

Sequence data revealed that all HCoVs have animal origins. The majority of emerging infectious diseases in humans have their origin in animals. Domestic animals may act as intermediate hosts that enable CoVs transmission to humans.[9] So far, seven Alphacoronavirus species and four Betacoronavirus species were identified in bats and, therefore, bats are likely the major natural reservoirs of these CoVs.[10] SARS- CoV, MERS- CoV, HCoV- NL63, and HCoV-229E are likely to be originated in bats and HCoV- OC43 and HKU1 from rodents. CoVs can mutate effectively and frequently which makes them so contagious. Gene exchange, insertion, deletions, and recombination are frequent in CoVs and that resulted in genome changes and may lead to future outbreaks. Different types of HCoV vary in their effects, spreading potential, and severity of the resulting disease. HCoV-OC43, HCoV-229E, HCoV- NL63, and HKU1 may cause mild and severe infections. Until the outbreak of SARS-CoV in 2002–2003, HCoVs were not considered to be highly pathogenic to humans. After SARS, another highly pathogenic MERS-CoV emerged in Middle Eastern countries. Both SARS-CoV and MERS-CoV can infect the upper and lower respiratory tracts. The symptoms of SARS and MERS develop over a week and start with a fever. Both illnesses spread through close contact with people who already have an infection and developed flu-like symptoms.[11,12] SARS-CoV-2 also caused severe and highly infectious pneumonia that leads to a pandemic[1,13]

Structure of Coronaviruses

CoV is a spherical or pleomorphic, single-stranded, enveloped RNA viruses of 80–160 nM in size and covered with club-shaped glycoprotein. CoVs are the largest known RNA viruses. CoVs have very high recombination and mutation rates because of frequent RNA Dependent RNA polymerase (RdRP) jumps and transcription[14] (Drexler *et al.* 2010). CoV- RNA genome codes for non-structural proteins (NSPs) and structural proteins (SPs).
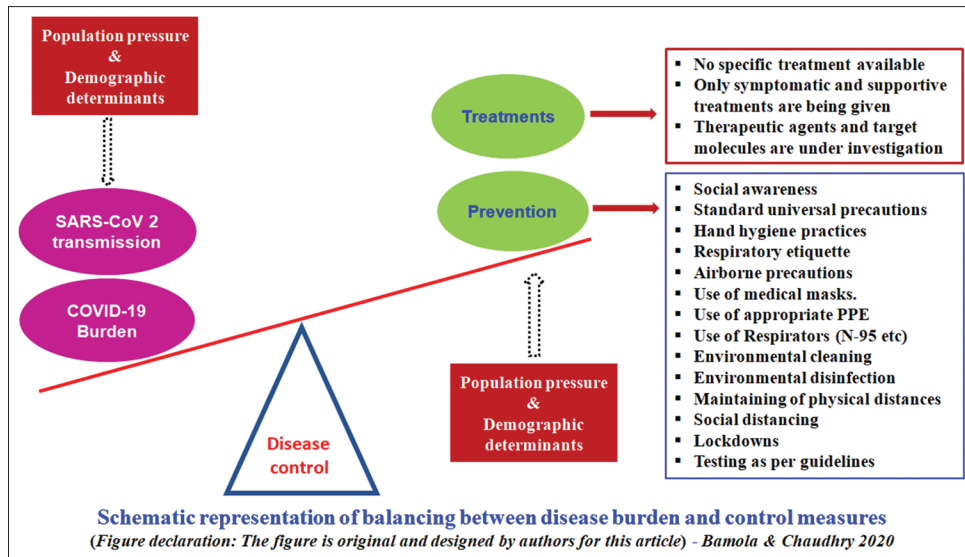
Figure 1: Schematic representation of balancing between disease burden and control measures
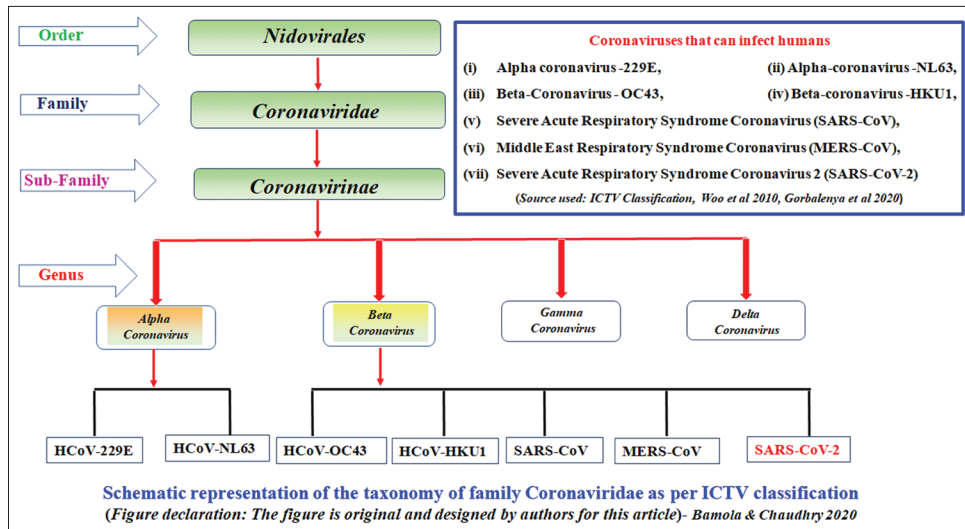

Figure 2: Schematic representation of the taxonomy of Coronaviridae as per ICTV

The structural proteins are spike (S), envelope (E), membrane (M) nucleocapsid (N), and other helper proteins. The CoV genome shows high variability for structural proteins and ORF1a/ORF1b.[15,16] A study reported several mutations and deletions on coding and non-coding regions after genetic analyses of 86 genomes of SARS-CoV-2.[17]

Structural proteins of CoVs help in the viral entry to the host cells, attachment to host receptors, and further replication. M-protein facilitates the binding to nucleocapsid and shape of virion particles. N-protein helps in binding of the genome to a replication- transcription complex and replication of genomic material. E-protein helps in the release and assembly of particles. E-protein of CoV is involved in several aspects of the viral life cycle including pathogenesis, envelope formation, assembly, and budding; therefore, CoVs lacking E-protein make potential vaccine candidates. The rapid transmission of certain CoVs

demanded the need for detailed research of CoV to develop effective anti-CoV agents.[15] SARS-CoV and SARS-CoV-2 belong to the same beta coronavirus subgroup with some genetic differences. SARS-CoV-2 has up to 70–85% sequence similarity with SARS.[4]

Figure 3- Schematic representation of the structure of SARS-CoV-2 virus

Transmission and Stability of SARS-CoV-2

CoVs can be transmitted from person-to-person and spread by fluids in the respiratory system. The initial cases in Wuhan, China were believed to be linked with direct exposure to infected animals and it was the animal-to-human transmission.[1] Now the virus crossed the political boundaries and reached the major portion of the globe. A most common source of SARS-CoV-2 infection

is symptomatic individuals but asymptomatic individuals could also transmit the virus and that is the big challenge in combating the disease.

- **Human-to-human transmission:** The main form of transmission of SARS-CoV-2 is human-to-human[18] and transmission occurs through the spread of respiratory droplets and can be spread by coughing and sneezing, touching, or shaking hands with a person who has the infection. The virus can pass through body secretions, eye discharge, close contacts, and making contact with a surface or object that has the virus.[19] SARC-CoV-2 transmission may also occur through fomites in the immediate environment around the patient[20] [Figure 4].

Figure 4- Representative chain of transmission of SARS-CoV-2 virus

- **Airborne transmission:** Airborne transmission of SARS-CoV-2 may be possible with prominent aerosol concentrations[21] in the settings which generate aerosols including ventilation, intubation, bronchoscopy, open suctioning, nebulization treatment, tracheostomy, and cardiopulmonary resuscitation. Studies reported that SARS-CoV-2, RNA was not detected in air samples from the setting where the symptomatic COVID-19 patients have been admitted. Although the detection of RNA in environmental samples does not indicate the presence of a viable virus.

- **Fecal–oral transmission:** Preliminary studies indicating the other mode of transmission of SARS-CoV-2 including fecal-oral transmission. Some evidence support that SARS-CoV-2 may cause intestinal infection and can be detected in feces. Isolation of SARS-CoV-2 from fecal samples and its gastrointestinal involvement support the importance of fecal-oral route transmission of the virus.[22] SARS-CoV-2 transmission is also reported via contaminated water, sewage, waste, air condition, and aerosols.[23]

- **Surface stability of SARC-CoV-2:** SARS-CoV-2 was reported more stable on stainless steel and plastic than cardboard and copper. Up to 72 h after application viable virus was detected on these surfaces.[24] On a copper surface after 4 h and on cardboards SARS-CoV-2 does not stay viable for more than 24 h. SARS-CoV-2 and SARS-CoV-1 are similar under experimenta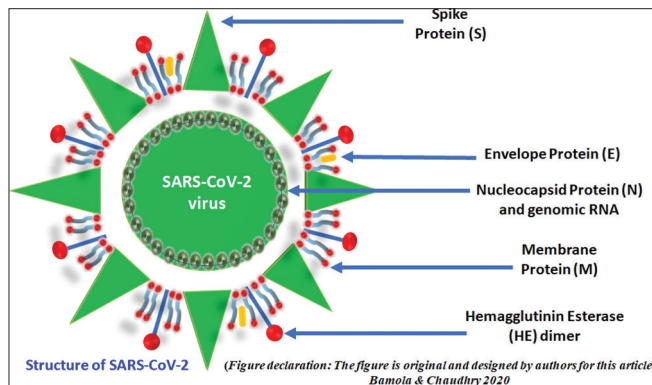l condition but the differences in the characteristics of these viruses may be due to high viral loads and a high potential for infection of SARS-CoV-2.[12,25] SARS-CoV-2 can be stable for up to 3 days or 72 h on plastic and steel surfaces; however, its concentration reduces after some period and significantly after 48 h.

- **Recommend precautions:** WHO, CDC, ICMR, European Centre for Disease Prevention and Control, European Society of Intensive Care Medicine, Society of Critical Care Medicine, recommend standard universal precautions, airborne precautions, and use of medical masks. Respirators (N95, FFP2, or FFP3) and other appropriate PPE are also recommended for those involved in the care of COVID-19 patients. Recommended guidelines emphasize appropriate use of PPE, hand hygiene, respiratory etiquette, environmental cleaning and disinfection, avoidance of unprotected contact, maintaining physical distances, and staff training.[2,26,27]

Mechanism of Action of SARS-CoV-2

The exact mechanism of action, receptors, and pathways involved in SARS-CoV-2 infection are under exploration and ongoing studies are regularly updating our understanding of the mechanism of action and pathogenesis of SARS-CoV-2 infection. In animals and humans, CoVs cause respiratory and intestinal infections. Until the outbreak of SARS-CoV and MERS-CoV, CoVs were not considered to be highly pathogenic to humans. SARS-CoV-2 has lower pathogenicity than SARS-CoV but higher transmissibility from humans to humans[28] (Li *et al.* 2020). These CoVs use host cellular components for different physiological processes, including an entry in the host cell, genomic replication, and pathological damage to the host. Virus infection begins by interaction with human cells followed by genome encoding which facilitates the expression of the genes. Encoding of accessory proteins of the virus helps in the adaptation of CoVs to their human host.[29]

Angiotensin-converting enzyme 2 (ACE2) receptors are probably the receptor for SARS-CoV-2 which is used by viruses for human
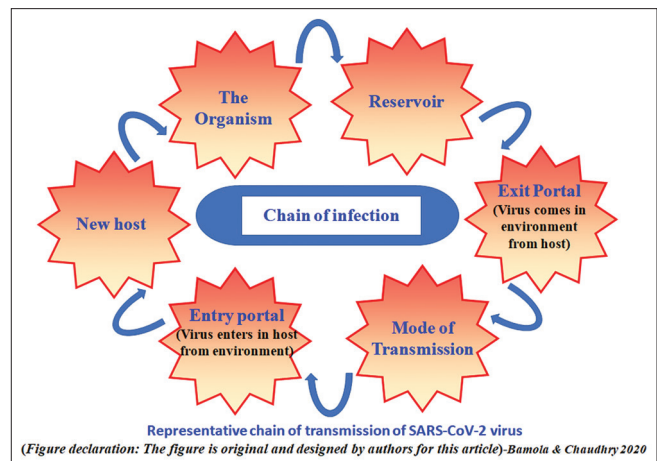

Figure 3: Schematic representation of the structure of SARS-CoV-2 virus

Figure 4: Representative chain of transmission of SARS-CoV-2 virus

infections.[30] ACE2 is highly expressed in the lungs and that makes the lung tissue more susceptible to SARS-CoV-2 infection. Theses ACE2 receptors are also expressed in the endothelial cells of the intestine.[31] SARS-CoV-2 interacts with the human ACE2 receptors which is further cleaved by serine protease/ protease (TMPRSS2) to activate virus entry and that are the most important events in the pathophysiology of COVID-19. After entering the cell, the viral poly-proteins are split by proteases resulting in complex RNA production through both replication and transcription. These viruses can infect the lower respiratory tract, intestines, liver cells, kidney cells, and T lymphocytes.[29] Further the virus can make irregular antiviral T-cell responses due to the stimulation of T-cell apoptosis.[30] The ACE2 receptor, serine protease inhibitor, and spike protein are mainly involved in the pathophysiology of SARS-CoV-2 and therefore, ACE2 blockers, spike protein-based vaccines, and serine protease inhibitors may have therapeutic potential for COVID-19 in the near future.[32]

Detection of SARS-CoV-2/COVID-19

Accurate and adequate testing of SARS-CoV-2 is the most important part of the prevention and management of the COVID-19 pandemic. WHO, CDC, and ICMR have issued guidelines and recommendations for the detection of SARS-CoV-2. Different countries have used different testing approaches for COVID-19 testing depending on testing capacity, public health resources, and the spread of the virus in the community. Different diagnostic tools to detect SARS-CoV-2 are being used around the globe. Tools are available for the diagnosis of symptomatic patients but the accurate determination of live viral shedding during convalescence and screening of asymptomatic patients in the disease incubation period remains major gaps in the diagnosis of COVID-19. Asymptomatic virus shedding is a big challenge to infection control.[25,33] Identification of asymptomatic carriers of the disease in the population is a serious challenge to counter the spread of infection and to combat with COVID-19 pandemic.

• CDC (US) COVID-19 Testing Guidelines and Strategy

CDC advised that clinicians should use their judgment based on patient symptoms to determine COVID-19 testing. The testing should be as per the following recommended priorities. High priority testing includes (i) hospitalized patients, (ii) healthcare workers, (iii) workers in congregate living settings (iv) the first responders with symptoms, (v) residents in long-term care facilities (vi) other congregate living settings with symptoms, including prisons and shelters, (vii) persons identified through public health cluster and selected contact investigations. CDC also advised priority testing which includes (i) persons with symptoms of potential COVID-19 infection, including cough fever, shortness of breath, vomiting or diarrhea, muscle pain, chills, loss of taste or smell, and sore throat, (ii) The testing is also recommended for persons who are prioritized by health departments or clinicians without symptoms, for any reason,

including screening, sentinel surveillance or public health monitoring.[34,35]

• ICMR (India) COVID-19 Testing Guidelines and Strategy for India

The National Task Force at ICMR issued guidelines and strategy for India. The recommendations are (i) Real-time PCR-based molecular test is the gold standard frontline test for COVID-19 diagnosis (ii) A rapid antibody test is a supplementary tool to assess the prevalence of the diseases within a specific area/ perimeter. (iii) A rapid antibody test cannot replace the frontline test. For epidemiological studies and surveillance purposes the rapid tests are useful, (iv) Rapid test will only be of use after 7 days of symptoms. ICMR recommended that the test has to be done under medical supervision for; (i) symptomatic individuals (ii) symptomatic contacts of laboratory-confirmed cases (iii) symptomatic healthcare workers (iii) patients with respiratory complaint, (iv) asymptomatic direct and high-risk contacts of a confirmed case.[26]

• Real-time reverse transcriptase-polymerase chain reaction (RT-PCR)

RT-PCR-based tests are the best method for the detection of SARS-CoV-2 infection. RT-PCR showed high specificity, sensitivity, and reproducibility and, therefore, approved as a Gold standard to detect SARS-CoV-2 infection and the reference standard for COVID-19 diagnostics.[36] Different test protocols have been developed for SARS–CoV-2 among those CDC has developed as the most widely used assay which used PCR primer-probe sets for two regions of the viral nucleocapsid gene (N1 and N2) and the human RNase P gene. WHO also developed the assessment for the detection of SARS–CoV-2 which used primer-probe sets that target the SARS–CoV-2 RNA-dependent RNA polymerase ($RdRP$) and envelope (E) genes.[37] Both assays developed by the CDC and WHO have high analytic sensitivity and specificity for SARS–CoV-2, with minimal cross-reactivity.[36]

• Specimen collection for testing:
COVID-19 tests required samples from the respiratory tract to assess the presence of nucleic acid targets of SARS–CoV-2.[37] A nasopharyngeal specimen is preferred but oropharyngeal, mid-turbinate, or anterior samples can also be used.[12,34] A lower respiratory tract aspirate or broncho-alveolar lavage sample and endotracheal aspirates samples also may be used and may have good sensitivity.[38] All the respiratory samples should be taken by using a flocked swab with an aluminum or plastic shaft to enhance the collection and release of cellular material. Swabs should be transferred into a universal transport medium immediately after collection to preserve viral nucleic acid. Swabs that contain calcium alginate, wood, or cotton should be avoided, because they may contain PCR inhibiting substances.[36]

• Serologic immunoassays:
Other then RT-PCR-based tests, rapid tests for point-of-care technologies, and serologic

immunoassays are also available and rapidly emerging around the globe. The market of theses rapid kits is blooming but the specificity, sensitivity, and reproducibility of most of them are not matching the mark, and some of those already being questioned in the field.

Symptoms of COVID-19

The understanding of symptoms of SARS-CoV-2 infections is increasing day by day although a detailed clinical spectrum of COVID-19 remains to be determined. A wide range of symptoms may appear 2–14 days after exposure to the virus in the patient. The inclusion in the COVID-19 symptoms is ongoing and recently CDC (US) updated the symptoms list. The patient may have symptoms or combinations of symptoms which include fever, chills, cough, sore throat, shortness of breath, muscle pain, headache, loss of taste or smell, persistent pain or pressure in the chest, bluish lips or face, and confusion or inability to arouse. Adults and children have similar symptoms but children generally have mild illness.[34,35] Children have a better prognosis than adults and the reported incidence of critical illness in children is low.[39,40] Some of the COVID-19 patients may present with a gastrointestinal infection. SARS-CoV-2 infection can result in cytokine storm syndrome (CSS), which may cause inflammation, fluid accumulation in the lungs, respiratory distress, and multiple organ failure, and can be fatal. The elderly and people with comorbidities and chronic illnesses are prone to severe infection and may lead to morbidity.[28]

Laboratory Features of COVID-19

Laboratory findings of SARS-CoV-2 infection include elevated C-reactive protein (CRP), LDH (lactate dehydrogenase), prothrombin time, D-dimer, ALT, and creatine kinase. Reduction in CD4 and CD8 lymphocytes were also noticed.[41] Intensive care patients have shown higher levels of interleukin (IL) IL-10, IL2, IL-7, interferon gamma-induced protein 10 (IP10), monocyte chemotactic protein1 (MCP1), granulocyte colony-stimulating factor (GCSF), macrophage inflammatory protein alpha (MIP1A), and tumor necrosis factor-α (TNF-α), coagulation activation, cellular immune deficiency, myocardial injury, renal injury, hepatic injury, increased amylase, and D-dimer levels.[42] An elevated level of procalcitonin is not a feature of COVID-19 which may suggest an alternative diagnosis such as bacterial pneumonia. Levels of CRP directly correlate with disease progression and severity.[41,42]

Prevention of COVID-19

There is no specific treatment and vaccine available to treat SARS-CoV-2 infection. WHO recommended that the management of COVID-19 by infection prevention, case detection, and monitoring and supportive care. Common preventive measures such as personal hygiene, hand washing, using disinfectant solutions, avoiding contact with patients, etc., are important measures that are being advised by different

international and national agencies. Quarantine, isolation, intensive contact tracing, travel restrictions can effectively reduce the spread of COVID-19. Surface disinfection with 62–71% ethanol, 0.5% hydrogen peroxide, or 0.1% sodium hypochlorite can inactivat HCoVs within 1 min.[43] In the current alarming situation of COVID-19, the whole world is mainly depending upon social distancing, isolation, quarantine, and lockdowns which have already proven the effect in the countries and territories where these measures have been taken timely, imposed efficiently, and followed adequately.

Treatment of COVID-19

Currently, no specific treatment is available for COVID-19 because of the absence of evidence. Currently, there are more than 300 RCTs that are ongoing but there is no strong evidence from any clinical trials on potential therapy showing improvement in COVID-19 patients.[5] In the current alarming spread of SARS-CoV-2, vaccination is an efficient and cost-effective means to prevent and control COVID-19.[44] Some vaccine candidates have also been identified to neutralize the COVID-19 and the clinical trials already started for a few of these vaccine candidates. A study identified a set of B-cell and T-cell epitopes from S and N proteins of SARS-CoV-2 and suggested that immune targeting of these epitopes may be used for protection against this virus.[45] Currently, some symptomatic and supportive treatments are being given which includes antipyretic, maintenance of hydration, respiratory support, and uses of antibiotics in co-bacterial infections in COVID-19. Based on previous experience and preliminary indications different guidelines have recommended a few supportive drugs to treat and manage COVID-19 in a case-specific manner. Current treatments are antiviral agents, chloroquine and hydroxychloroquine, corticosteroids, antibodies, and convalescent plasma transfusion.[46]

• Chloroquine and hydroxychloroquine:

Chloroquine (CQ) and hydroxychloroquine (HCQ) both exhibit similar inhibitory and antiviral effects with a good safety record.[47,48] HCQ is more safe has a lower level of tissue accumulation than CQ and could serve as a better therapeutic approach for the treatment of SARS-CoV-2 infection.[30,49] HCQ is a repurposed antimalarial drug that interferes with the virus's endosomal entry pathway. HCQ is likely to attenuate the severe progression of COVID-19 inhibiting the cytokine storm by suppressing T-cell activation.[30] Based on preliminary evidence, regulatory agencies of different countries recommended the use of HCQ for the prevention and treatment of COVID-19. However, large scales RCTs are required to assess the effects of HCQ in COVID-19.

• Antiviral agents the treatment of COVID-19

There is no effective antiviral therapy against COVID-19.[50,51] Broad-spectrum antiviral drug remdesivir, protease inhibitors

lopinavir, and ritonavir that showed symptomatic improvement in COVID-19 patients also indicated modest antiviral activity against SARS-CoV-2.[50-53] Initial studies also showed the therapeutic potential of antiviral drug favipiravir that interferes with viral replication.[54] A combination of chloroquine and remdesivir effectively inhibits the SARS-CoV-2.[22] Antiviral drugs oseltamivir, peramivir, zanamivir, ganciclovir, acyclovir, and ribavirin are ineffective and not recommended for COVID-19.[28] Systematic corticosteroids should not be given routinely for the treatment of COVID-19.[55] Angiotensin-converting enzyme inhibitors are also advised for COVID-19 patients.[56]

• **Convalescent plasma therapy:** Convalescent plasma (CP) therapy is adaptive immunotherapy which has been used for the prevention and treatment of different infectious diseases. CP therapy showed satisfactory efficacy and safety in the treatment of SARS, MERS, and 2009 H1N1 pandemic and now is being given to critical cases of COVID-19 and has shown moderate effects.[33,57] CP therapy is also approved by US-FDA and ICMR-India in cases specific manner for the critically ill patients of COVID-19. Randomized clinical trials of CP therapy already have been started in different countries including India.

Conclusion

SARS-CoV-2 is a highly communicable virus causing the COVID-19 pandemic. RT-PCR is the best method for the detection of SARS-CoV-2 infection. Symptomatic patients are a major source of infection spread but asymptomatic carriers of the infection in the population area serious challenge to combat with COVID-19 pandemic. COVID-19 is a new disease and currently, there is no proven treatment available. Preventive measures are the best resources to deal with this COVID-19 pandemic. SARS-CoV-2 enters the host cell to use host cellular components to survive in the host. The serine protease, viral S protein, E protein, and ACE2 receptors are an important component of SARS-CoV-2 pathophysiology. Strategy to disrupt the viral life cycle may serve as a potential therapeutic target for developing antiviral therapies, therefore, the serine protease inhibitors, S and E protein-based vaccines and ACE2 blockers may have therapeutic potential for the treatment of COVID-19 in the future. WHO, CDC (US), and ICMR (India), etc., recommended few supportive therapies to treat and manage COVID-19 in a case-specific manner. Antimalarial drug hydroxychloroquine, antiviral drugs favipiravir, remdesivir, lopinavir, and ritonavir showed symptomatic improvement in COVID-19 patients and are being used globally. Convalescent plasma therapy is also being used in a case-specific manner for the critically-ill and comorbid patients of COVID-19. Potential therapeutic agents are under testing and experimental investigations but no molecule and therapy have been found effective for COVID-19 so far. Therefore, rapid and large-scale studies are needed to provide effective management of COVID-19 and to increase our preparedness for such future virus outbreaks.

Key points

- SARS-CoV-2 transmission can occur by direct contact with infected people and indirect contact with surfaces in the immediate environment used by an infected person
- SARS-CoV-2 interacts with human cells through spike protein followed by genome encoding which facilitates the expression of the genes
- Angiotensin-converting enzyme 2 (ACE2) receptors are probably the cell receptor for SARS-CoV-2 which is used by viruses for human infections
- The ACE2 receptor, serine protease inhibitor, and spike protein are mainly involved in the pathophysiology of SARS-CoV-2 and therefore, ACE2 blockers, spike protein-based vaccines, and serine protease inhibitors may have therapeutic potential for COVID-19
- Real-time reverse transcriptase-polymerase chain reaction (RT-PCR)-based assays are the best method for the detection of SARS-CoV-2 infection
- Based on previous experience and preliminary indications different guidelines recommended a few supportive drugs and pharmaceutical preparation to treat and manage COVID-19 in a case-specific manner
- Antimalarial drug hydroxychloroquine, antiviral drugs remdesivir, lopinavir, and ritonavir for the management of COVID-19 are being used globally
- Convalescent plasma therapy is also being used in a case-specific manner for the critically-ill and comorbid patients of COVID-19
- Potential therapeutic agents are under testing and experimental investigations but no molecule and specific therapy have been found highly effective for COVID-19 so far
- Quarantine, isolation, intensive contact tracing, and travel restrictions are effective to control and reduce the spread of COVID-19.

Conflicts of interest

There are no conflicts of interest.

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