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Therapeutic and Diagnostic Approaches for SARS-CoV-2

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Abstract

Epidemic control of severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infections is becoming a global health crisis and diagnostic testing to identify infected persons is indispensable. Although various aspects of the virus are still unknown to the public, early diagnosis, lockdown, and supportive care are required to treat patients. This paper reviews the literature on available information about the diagnostic method with greater emphasis on next-generation sequencing (NGS) technology and a novel therapeutic approach to COVID-19.

Keywords

COVID-19 Diagnostic Testing, Severe Acute Respiratory Syndrome Coronavirus 2, COVID-19 Drug Treatment, High-Throughput Nucleotide Sequencing

1. Introduction

There is a considerable health threat to humans by the emergence and spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the world (Chawla et al., 2020).

To help advance the diagnosis of COVID-19, we describe here different testing methods with greater emphasis on next-generation sequencing (NGS) technology, which caused to sequence discovery of a novel human coronavirus. In the following, we will explain the standard methods of treating patients and give

a brief reference to the use of new treatment technologies that might be used to cure this disease.

2. The Overview of SARS-CoV-2 Virus

The experts at the People's Republic of China (PRC) Centers for Disease Control recognized a virulent coronavirus as novel coronavirus pneumonia (NCP) for the first time (Wang, Wang, Ye, & Liu, 2020). Afterward, the name of the disease was introduced by World Health Organization (WHO) as coronavirus disease-2019 (COVID-19) (Wan et al., 2020). On 7 January 2019, scientists called it a 2019 novel coronavirus (2019-nCoV). Meanwhile, it was renamed SARS-CoV-2 by the International Committee on Taxonomy of Viruses (Yuen, Ye, Fung, Chan, & Jin, 2020). This virus belongs to the β-coronavirus family, a significant class of viruses that are widespread (Li, Liu, Yu, Tang, & Tang, 2020). COVID-19 is a biological hazard and becomes a political and economic threat to healthcare worldwide (e Silva & de Carvalho, 2020). SARS-CoV-2 has potential definitive and intermediate hosts like several viruses, but its transmissibility is higher than the Middle East respiratory syndrome coronaviruses (MERS-CoV). Thus, there are significant challenges for the elimination and treatment of COVID-19 (Liu, Gayle, Wilder-Smith, & Rocklöv, 2020).

The main entry point of the virus to the cell is Angiotensin Convertase Enzyme 2 (ACE2) receptor. It is located on the surface of the nasal mucosa, bronchus, lung, heart, esophagus, kidney, stomach, bladder, and ileum cells, so all of these organs are susceptible to SARS-CoV-2. ACE2 is the primary receiver of the spike protein of the SARS-CoV-2 (Fekrazad, 2020). The Spike protein of the COVID-19 consists of two parts: S1 and S2. The first is for primary attachment, while the second is for viral infusion (Belouzard, Millet, Licitra, & Whittaker, 2012).

3. Definitive Diagnosis of COVID-19

The growing concerns regarding the COVID-19 pandemic cause pathogen discovery of novel CoVs now consider even more important than in the past (Xiu et al., 2020). As 2019-nCoV is a newly discovered virus, there is limited availability of laboratory-based diagnostic tests for it. Among all of the laboratory tests with their pros and cons (**Table 1**), viral nucleic acid testing can prevent the more spread of the COVID-19. It is commercially available for the detection of pathogenic organisms (Phan, 2020).

Metagenomics analysis using next-generation sequencing technology (mNGS) leads to sequence discovery of several CoV strains of four genera. These strains are genetically similar to human viruses within the beta coronaviruses (β-CoV), such as the bat SARS-related Coronaviruses; the new sequence also is added to the GenBank (Gorbalenya et al., 2020). Briefly, a sample of RNA based-mNGS approach may be collected from bronchoalveolar lavage fluids (BALF) in which nucleic acids are extracted, and synthesized cDNA is prepared for the sequencing library. Then, high-throughput sequencing is performed on each library.

Table 1. Current and upcoming SARS-CoV-2 diagnostic tests.

Technology	Method	Advantage	Disadvantage
Nucleic acid detection technology	RT-PCR	- High sensitivity and specificity. - Effective and straightforward method. - Coinciding amplification and analysis in a closed system to minimize false-positive. results associated with amplification product contamination. - Accurate diagnoses because it can target and identify specific pathogens. - Reduced turnaround times (Cho et al., 2014).	- Jeopardizing the diagnostic accuracy by some pre-analytical and analytical variables. - The false-negative rate of the technique is unneglectable. - The availability of PCR reagent kits has not kept up with demand due to the shortage of kits and a false negative RT-PCR rate. - The PCR infrastructure to handle high sample throughput is inadequate in community hospitals outside of metropolitan cities. - It depends on the presence of SARS-CoV-2 observable in the collected sample. So, if an asymptomatic patient was infected with SARS-CoV-2 but has since recovered, PCR would not identify this prior infection. - Primers in the ORF1a/b and N genes of COVID-19 can be affected by the variation of viral RNA sequences. - Certain biological safety hazards brought by the retention and operation of patient samples. - Nucleic acid detection operations are cumbersome and multistep. - Time-consuming process for results. - Expensive and depend upon technical expertise (Xiao et al., 2020).
	High-throughput sequencing	- The authoritative identification method for SARS-CoV-2 is high-throughput sequencing of the whole genome (Li, Geng, Peng, Meng, & Lu, 2020).	- Equipment dependency. - High cost (Reuter, Spacek, & Snyder, 2015).
	LAMP and RT-LAMP	- Simple to operate. - Easy to visualize for detection. - Fewer background signals. - No need for a thermocycler. - More robust and more detection-sensitive compared to PCR. - High specificity and sensitivity. - Simple to perform (Nguyen, Duong Bang, & Wolff, 2020).	- Low detection rate for SARS-CoV-2 and thus needing to be repeated 2 to 3 times in many cases. - Patients have not been diagnosed promptly and thus have missed the chance of early isolation and early treatments are restricted by false-negative results and detection limitations.
	Isothermal amplification	- Isothermal amplification multiplexed at the amplification and/or readout stage. - Multiplexing increases the amount of information gained from a single test and improves clinical sensitivity and specificity. - Barcoded-bead assays/systems are engineered for laboratory use (Udugama et al., 2020).	- The challenge lies in the configuration of the system for reading. - A dynamic barcode signal extracted from organic molecules involve a precise instrument configuration to differentiate the codes.
	CRISPR-based SHERLOCK	- Much faster than detection by qRT-PCR. - High sensitivity (Dara & Talebzadeh, 2020).	- Taking time to perform. - It has been saddled with concerns regarding sensitivity (identifying people who have the disease) and specificity (identifying people who don't have the disease) (LeMieux, 2020).

Continued

Immune identification technology	Serological methods such as serological ICG strip assay	- Sensitive and consistent. - An excellent supplementary approach in clinical application. - Showing how many people have had the disease, including those whose symptoms were minor or who were asymptomatic (Pan et al., 2020). - It can be widely adopted in the areas where the diagnostic capacity is limited.	- No finding antibodies in someone with a current COVID-19 infection since antibodies may not show up for weeks.
	POCT	- Unlike nucleic acid samples, with the advantages of identification following recovery. - This helps physicians to track patients who are both ill and recovered, offering a greater estimation of SARS-CoV-2 overall infections. - Simple cassette-based test that works with just 10 - 20 µl of serum, plasma, or whole blood. - Cost-effective, rapid, hand-held devices used to diagnose patients outside of centralized facilities. - It can reduce the burden on clinical labs in locations such as community centres. - To diagnosis patients without submitting samples to centralized hospitals, point-of-care tests are used to allow communities without laboratory resources to identify infected patients. - Rapid antigen lateral flow assays would theoretically provide the advantage of fast time to 165 results and low-cost detection of SARS-CoV-2. - Miniaturization, limited sample length, fast detection times and portability are the main benefits of using microfluidics. - It does not necessarily require a trained technician to operate.	- Poor sensitivity with lateral flow for influenza (Flu) viruses. - It is always a challenge to balance between maximizing the sensitivity/specificity of each pathogen and the multiplexing capabilities. - Probability of cross-reactivity (Pang, Chia, Lye, & Leo, 2017).
	Protein Testing	- Useful for surveillance of COVID-19 (Udugama et al., 2020).	- Change of viral load over the course of the infection can make viral proteins challenging to detect. - Developing theoretical cross-reactivity of SARS-CoV-2 antibodies against other coronaviruses with antibodies.
	ELISA and GICA	- Higher detection rates than nucleic acid detection. - Simple, fast, and safe. - The results can be used for clinical reference, and the huge clinical diagnosis and treatment pressure can be greatly relieved.	- Its confirmation still depends on qRT-PCR (Xiang et al., 2020).
Computed tomography	CT scan	- It is essential for early diagnosis and differential diagnosis and disease severity assessment, especially in the high prevalence area of SARS-CoV-2 Infection. - Timely and rapid to detect lung lesions and has a high positive rate. - Irreplaceable in the preliminary screening of COVID-19. - Simple to perform and readily available - Non-invasive and it involves taking many - X-ray measurements at different angles across a patient's chest to produce cross-sectional images (Dai et al., 2020).	- Low specificity due to false-negative rate because of the severe consequences of missed diagnosis from other viral pneumonia caused by influenza A virus, influenza B virus, Cytomegalovirus, Adenovirus, respiratory syncytial virus, MERS Coronavirus, and different viral types of pneumonia as well as bacterial pneumonia. - Expensive. - Require technical expertise.

Continued

Routine test	Elevated levels of C-reactive protein and D-dimer, neutrophil count, NLR ratio, and a lower lymphocyte count	- Monitor and predict the severity and prognosis of COVID-19 (Zeng et al., 2020).	- Low specificity because they are also abnormal in other illnesses.
Combined test		- Useful for certain negative screening tests for people with elevated clinical suspicion of SARS-CoV-2 infection. - Improvement in management of the SARS-CoV-2 outbreak significantly increase patient compliance for quarantine and treatments.	- High cost (Wang, Kang, Liu, & Tong, 2020).
Culture		- Effective and often complementary.	- Increased risk to laboratory staff. - Time-consuming. - Labor-intensive. - Often lack sensitivity or specificity (Cho et al., 2014).

LAMP: Loop-mediated isothermal amplification; RT-LAMP: Reverse transcription LAMP; ELISA: Enzyme-linked immunosorbent assay; GICA: Colloidal gold-immunochromatographic assay; NLR: Neutrophil-to-lymphocyte; qRT-PCR: Quantitative reverse transcription polymerase chain reaction; CRISPR/Cas: Clustered Regularly Interspaced Short Palindromic Repeats; POCTs: Point-of-care tests; ICG: immunochromatographic; CT: Computed tomography.

Sequenced reads are mapped to the reference 2019-nCoV genomic sequences. These reads are translated into the single intact open reading frame gene. Afterward, the aligned amino acid sequences are categorized based on the same mutations/deletions in the S1/S2 region and ranked by frequency of occurrence. In this method, complete and partial 2019-nCoV genome sequences can be obtained (Zhou et al., 2020).

NGS can result in increased surveillance for infection prevention and patient management due to the investigation of infectious agents from original clinical samples directly. Primarily, RNA based-mNGS approach could determine concomitant the whole "infectome" (i.e., RNA/DNA viruses, Prokaryotes, and Eukaryotes) present within an organism (Chen et al., 2020). This technology shows higher sensitivity than conventional RT-PCR. It can be used in various aspects of virus detection, including double-check detection, secondary diagnosis, and suspected sample detection to be RT-PCR false-negative (Xiao et al., 2020).

NGS may be used unbiased evolutionary analysis of bat CoVs that considers their high genetic diversity because of its high-throughput sample processing and need the compilation of whole-genome sequences (WGS) (Li et al., 2020). It can also be a laboratory-confirmatory 2019-nCoV infection test for patients or pregnant women with suspected cases of COVID-19 pneumonia (Deng et al., 2020). As defective viral genomes (DVGs) containing genomic deletions are generated during CoV replication, direct analysis of these recombined CoV RNAs is feasible with the advent of NGS technology. This technology minimizes the risk of handling infectious viral cultures and enables new scientific inquiry (Gribble et al., 2021). Genome Detective Coronavirus Typing Tool is a software

application of NGS to assemble all known virus genomes that can monitor novel viral mutations as the outbreak expands globally. It may improve new diagnostics, medicines, and vaccines to prevent the COVID-19 infection (Cleemput et al., 2020).

Activities have been carried out to decrease labor and overall turn-around time and increase the cost-effectiveness of this technique. One of them is the usage of the bioinformatics process for physically separating reads derived from host DNA and RNA. The other activity is related to Virome Capture Sequencing to off-target enrichment of viral nucleic acid relies on predesigned viral probes considering balancing depth and length of coverage that share more than 60% homology with the target virus sequence resulting in decreasing essential metagenomics sequencing effort. Amplicon- or PCR-based and hybridization capture-based enrichment (hybrid capture) are two major enrichment strategies for targeted sequencing (Nasir et al., 2020).

The other strategy is based on testing only the minimal region of the virus essential for interacting with the host receptor, where dramatically reduces cost and synthesis production time for testing several spikes for entry in the system (Letko & Munster, 2020).

On the other hand, despite all of the efforts to apply high-throughput sequencing technology in clinical diagnosis and become more inexpensive each consecutive year, the high expense is still the most indispensable barrier to generalize virus sequencing these days (Xiao et al., 2020).

Equipment dependency, time-consuming, sophisticated library preparations, and data processing and missing low-abundance CoV sequences due to the high background level of nonviral sequences present in surveillance field samples are the other its limitation. Also, an inherent deficiency of sensitivity with an unbiased approach increases data analysis burden and decreases the chance of detection in field samples with low viral loads.

It is highly recommended that employing novel coronavirus surveillance, including pan-CoV assay and other pan-viral assays, among people who exposure to animals for a long time because there are some common viruses between humans and animals. This surveillance can be through cell culture, full genome sequencing, and seroepidemiology of both the worker and the animals if indicated (Xiao et al., 2020).

Based on the items stated above, it can be concluded that combined screening strategies may be the more efficient way to identify new CoVs.

4. Novel Therapies

Since the molecular mechanism of pathogenicity of this virus remains to be fully determined, there is still presently no vaccine or specific antiviral drug regime used to treat critically ill patients. Currently, treatment provided to the affected individuals is the main symptom-based (Vellingiri et al., 2020). Oxygenation, ventilation, and fluid management are used as the provision of supportive care.

The recent catastrophic prevalence of COVID-19 highlights the immediate introduction of potential therapeutics targeting SARS-CoV-2. Forasmuch as it seems unlikely that the development of drugs specific for COVID-19 will take at least in the coming months, medications that have been proven to be safe for humans can be repurposed to treat this disease. Drugs used to treat SARS-CoV-2 are mostly based on their effectiveness on primary strains of coronavirus, SARS-CoV, and MERS-CoV (Rismanbaf, 2020). The vast majority of the medicines utilized for treatment around the world are discussed below.

4.1. Antiviral

Drugs under anti-viral category generally follow the inhibition of one of the following three mechanisms: viral replication, ion channel, and serine proteases (Razonable, 2011).

4.2. Remdesivir

Remdesivir is an adenosine triphosphate analog first described in 2016 as a potential effector on the treatment Ebola. This drug is a nucleotide analog, which was used to treat against Ebola virus, Marburg virus, SARS-CoV and MERS-CoV (Elfiky, 2020; Warren et al., 2016). In order to treatment COVID-19, Remdesivir was granted an FDA Emergency Use Authorization on 1 May 2020 (Ison, Wolfe, & Boucher, 2020). However, this is not the same as an FDA approval (Sung et al., 2020).

4.3. Lopinavir/Ritonavir

Protease inhibitors, are an integral component of highly active antiretroviral therapy (HAART) (Kohlrausch, de Cássia Estrela, Barroso, & Suarez-Kurtz, 2010). Lopinavir/ritonavir is a protease inhibitor combination used for the treatment of HIV infection (Gupta et al., 2008).

Lopinavir generates little systemic concentrations when used alone, it is extensively metabolized by CYP3A4. Ritonavir can increase Lopinavir concentration by potently inhibiting the CYP3A4 (Corbett, Lim, & Kashuba, 2002). It may be applied as a component of initial or salvage therapy.

Literature has demonstrated, after prescribing this composition, β-coronavirus viral loads notably decreased and no or little coronavirus titers were observed (Shen et al., 2020). In contrast, other studies have shown that the use of lopinavir-ritonavir to treat hospitalized adult patients with severe Covid-19, was not associated with clinical improvement or mortality in seriously ill patients (Cao et al., 2020).

4.4. Ribavirin

Ribavirin is a broad-acting antiviral drug whose therapeutic potential was uncovered during 1972. It is a guanosine analog that interferes with the replication of RNA and DNA viruses and is used to treat different viruses in combination with

immunomodulators (interferon α) or direct-acting antivirals (Gane et al., 2013; Manns et al., 2001). It inhibits natural guanosine generation by directly inhibiting inosine monophosphate dehydrogenase (Khalili, Zhu, Mak, Yan, & Zhu, 2020). Ribavirin was the standard of care therapy in hepatitis C virus (HCV) infection (Ampuero & Romero-Gómez, 2016; Cusato et al., 2018). This drug is phosphorylated by adenosine kinase and cytosolic 5'-nucleotidase and it is transported into cells by concentrative nucleoside transporters (Allegra et al., 2015). The wide availability and low cost of ribavirin support its potential to significantly impact the treatment of COVID-19 infections.

4.5. Favipiravir

Favipiravir is a pyrazine carboxamide derivative (6-fluoro-3-hydroxy-2-pyrazinecarboxamide) that is considered a purine nucleic acid analog and a potent RNA polymerase inhibitor. It is a broad-spectrum antiviral drug approved for the treatment of influenza (Du & Chen, 2020). This drug has obtained approval from Shenzan Health Commission for treating COVID-19 patients (Wu et al., 2020). According to a study by Cai et al., patients with COVID-19 who were treated with Favipiravir have a significantly higher improvement rate in chest imaging and furthermore, they showed significantly better treatment effects on COVID-19 in terms of disease progression and viral clearance (Cai et al., 2020).

4.6. Sofosbuvir

Sofosbuvir is a potent nucleotide HCV Non-structural protein 5 (NS5B) polymerase inhibitor (Cusato et al., 2018). Sofosbuvir is an approved drug by the FDA against HCV in the year 2013 (Elfiky, Gawad, & Elshemey, 2016; Lam et al., 2012). It gives excellent results against other viruses including the Zika virus (Bullard-Feibelman et al., 2017). It was used in combination with interferon or Ribavirin. Additionally, studies have shown sofosbuvir as a potent inhibitor against the newly emerged COVID-19 strain (Elfiky, 2020).

4.7. Anti-Malarial Agent

Chloroquine is an amine acidotropic form of quinine (Winzeler, 2008) and hydroxychloroquine by the presence of a hydroxyl group at the end of the side chain, differs from chloroquine. For decades, chloroquine/hydroxychloroquine was widely-used as an anti-malarial and autoimmune disease drug (Devaux, Rolain, Colson, & Raoult, 2020). Previous studies reported that chloroquine/hydroxychloroquine possesses the potential of inhibiting the exacerbation of pneumonia due to its anti-viral and anti-inflammatory activities (Cunningham, Goh, & Koh, 2020; Zhang et al., 2020). Chloroquine/hydroxychloroquine is known to block virus infection by increasing endosomal pH, in addition, can prevent SARS-CoV from effect? The glycosylation of a virus cell surface receptor, ACE2 (Lajoie, Mwangi, & Fowke, 2017; Wang et al., 2020). A very recent publication of results showed that chloroquine can reduce the SARS-CoV-2 viral

load and shorten the duration of viremia (Vellingiri et al., 2020). There are side effects to these medications, serious retinopathies and cardiopathies associated with bioaccumulation of the drugs are described in the literature (Palmeira, Costa, Perez, Ribeiro, & Lanza, 2020).

4.8. Immunologically Based Strategies

Uncontrolled and excessive cytokine release, also known as cytokine storm (Zhu et al., 2020). Cytokine storm syndrome can be caused by a variety of diseases, including infectious and non-infectious diseases. Accumulating evidence revealed that patients hospitalized with severe COVID-19 have an elevated cytokine profile, similar to cytokine storm (Ye, Wang, & Mao, 2020). The immune system attacks the body by the cytokine storm, which in turn will lead to Acute Respiratory Distress Syndrome (ARDS) and multiple organ failure, at least in the most severe cases of SARS-CoV-2 infection, the final result being death. Interferons, interleukins, chemokines and TNF-alpha represent the main ingredients involved in the expansion of the Cytokine storm (Coperchini, Chiovato, Croce, Magri, & Rotondi, 2020; Xu et al., 2020). As far as we know, there are a diversity of anti-inflammatory medicines, including non-steroidal anti-inflammatory drugs, glucocorticoids, inflammatory cytokines antagonists (such as IL-6R monoclonal antibodies, TNF inhibitors, IL-1 antagonists, Literature suggested that tailored anti-inflammatory therapy can reduce systemic inflammation before it overwhelmingly results in multi-organ dysfunction (Vickers, 2017; Zhang et al., 2020).

However, there is a dilemma of anti-inflammatory therapy and creating a balance between balancing the risk and benefit ratio is a critical issue. It is important that we know whether anti-inflammation therapy is helpful in treating COVID-19 patients, at what stage and for how long should we use anti-inflammation therapy? Also, which anti-inflammatory medications are helpful? (Zhang et al., 2020) Our major concern is that anti-inflammatory therapy, such as corticosteroid, may delay the elimination of virus and increase the risk of secondary infection.

4.9. Convalescent Plasma

Passive immunization has been successfully used to treat infectious diseases. As we know, the SARS-CoV-2 entry into the target host cells by binding the S protein to ACE2 receptors. By employing neutralizing antibodies against the ACE2 receptors, there is a high possibility for reducing the severity of the disease (Zheng & Song, 2020). Neutralizing antibody titers increase in the plasma of patients who have recently completely recovered from the COVID-19.

A systematic review describes a considerable decrease in mortality and viral load in studies using convalescent plasma for the treatment of severe acute viral respiratory infections, including those caused by related coronaviruses (SARS-CoV and MERS-CoV) (Cunningham et al., 2020).

But on the contrary, it is not yet clear whether convalescent plasma can cure

critically ill patients with COVID-19 and ARDS. An important point to consider when using this technique, the need for adequate selection of donors with high neutralizing antibody titers (Lim et al., 2020).

4.10. Novel Treatment Strategies

Our modern world inaccessibility to a method that can destroy the virus or stop its speed brings us to the fact that today's world needs new techniques to deal with emerging diseases (Boluki et al., 2017; Pourhajibagher et al., 2016). COVID-19 pandemic proves the ineffectiveness of current methods to deal with coronavirus. Here, we will discuss some of the newer ways to deal with microorganisms.

Light-based antimicrobial therapy strategy relies on the ability to eradicate microbes regardless of antibiotic resistance (Pourhajibagher et al., 2016). Briefly, the basis of the photodynamic therapy (PDT) mechanism is a combination of non-toxic photosensitizers (PSs) and harmless visible light that produce reactive oxygen species (ROS). The ROS's can oxidize biomolecules and thereby kill cells. Nucleic acids (DNA or RNA), virus proteins and if present, viral lipids are three main molecular targets for PDT and reaction with the generated ROS (Wiehe, O'Brien, & Senge, 2019). SARS-CoV-2 with lipids and a protein envelope, in general, seems to be more vulnerable to PDT than those without (Baptista et al., 2017; Girotti, 2001). PDT is a clinically approved, minimally invasive therapeutic procedure that is used for the treatment of infections and can exert a selective cytotoxic activity toward malignant cells (Agostinis et al., 2011). It is an exceptional treatment strategy, So that in addition to its direct effect on biomolecules, the PS may activate the immune system to attack target cells (Taylor, 2007).

One of the major challenges with COVID-19 pandemics is that the virus SARS-CoV-2 is transmitted between people through direct contact and bioaerosols. Discovery of antiviral procedure for indoor air purification can be beneficial to solve this problem. One of the new technologies that have recently been used to kill microorganisms in the air is the photocatalyst technique (Moshfegh, Khosraviani, Moghaddasi, Limoodi, & Boluki, 2021). Photocatalysis has recently emerged as an effective green solution for antimicrobial disinfection applications (Boluki, Pourhajibagher, & Bahador, 2020; Ganguly, Byrne, Breen, & Pillai, 2018). Utilizing air purification systems based on photocatalyst method can easily disrupt the transmission chain of this virus through the air.

The interaction of nanomaterials with Infectious agents is fast-revolutionizing the biomedical field by offering advantages in both diagnostic and therapeutic applications. Nanoparticle offers unrivaled Physico-chemical properties that have linked benefits for drug delivery as ideal tools for viral treatment (Cojocaru et al., 2020). The notable features of these compounds include, the particle size (which affects bioavailability and circulation time), the large surface area to volume ratio (raise solubility), contains a hollow volume that can accommodate a drug payload, surface charge tunable, and the possibility of encapsulation (de Vries et al., 2020; Kerry et al., 2019; Tebaldi, Belardi, & Montoro, 2016).

These properties generate great expectations for the nanoparticulate drug.

Progresses of nanotechnology in antiviral therapy can deliver new therapeutic strategies to explore to achieve and improve therapeutic effects.

5. Conclusion

SARS-CoV-2 is spreading rapidly and has a high rate of mutagenesis and changes in structure, which scientists are endeavoring to discover antivirals specific for its efficacious treatment (Vellingiri et al., 2020). Confronting the challenge of the outbreak of COVID-19 should sharpen the focus on global drug access as a key issue in antiviral therapy. The testing and adoption of effective therapies for novel coronaviruses are hampered by the challenge of conducting controlled studies during a state of emergency (Khalili et al., 2020). The pathology of COVID-19 resembles that of the 2013 MERS-CoV and 2003 SARS-CoV infections such that the extrapolation of treatment guidance from those prior clinical experiences can provide guidance for the current outbreak of 2019-nCoV (Liu et al., 2020).

SARS-CoV-2 diagnosis can be based on detection of the virus presence by nucleic acid test and antibodies (serological tests) produced in response to infection as well as medical imaging.

Obviously, combining assessment of imaging features with clinical and laboratory findings could facilitate early diagnosis of COVID-19. The critical need for treatment and patient care in outbreak settings, on the frontlines of nCoV outbreaks, will place stress on any medical system and clinical research mechanism. Accordingly, in this review, we have summarized recent progress in treatment strategies of COVID-19 and discussed various diagnostic methods for SARS-CoV-2 which may lead to help clinicians make more efficient, data-informed decisions and battle against SARS-CoV-2.

Conflicts of Interest

Authors declare that they have no conflict of interests.

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