ISSN: 2157-7439
Journal of
Nanomedicine & Nanotechnology

Review Article

Role of Nanomaterial of SARS-CoV-2: Prevent, Diagnose and Treat COVID-19

Anisimov Roman*

Department of Networks and Information Security, Faculty of Information Technology, Al-Ahliyya Amman University, Amman, Jordan

ABSTRACT

Following the global COVID-19 pandemic, nanotechnology has been at the forefront of research efforts and enables the fast development of diagnostic tools, vaccines and antiviral treatment for this novel virus (SARS-CoV-2). In this review, we first summarize nanotechnology with regard to the detection of SARS-CoV-2, including nanoparticle-based techniques such as rapid antigen testing, and nanopore-based sequencing and sensing techniques. Then we investigate nanotechnology as it applies to the development of COVID-19 vaccines and anti-SARS-CoV-2 nanomaterials. We also highlight nanotechnology for the post-pandemic era, by providing tools for the battle with SARS-CoV-2 variants and for enhancing the global distribution of vaccines. Nanotechnology not only contributes to the management of the ongoing COVID-19 pandemic but also provides platforms for the prevention, rapid diagnosis, vaccines and antiviral drugs of possible future virus outbreaks.

Keywords: COVID-19; Nanotechnology; SARS-CoV-2; Diagnosis; Vaccines

INTRODUCTION

Coronavirus has become a global epidemic and a major public health concern in a relatively short period of time. People's health, safety, and economic well-being have been negatively impacted by the epidemic. COVID-19 side effects ranged from minor to acute and included everything from acute lung sickness to cardiogenic shock and even death. As of January 2022, 350 million cases have been confirmed and the total deaths more than 5 million peoples. Those who are elderly or who have diseases that are dormant are more likely to suffer from life-threatening consequences. From then on, significant efforts were committed to promoting prevention, diagnostic, and therapeutic approaches to combat the COVID-19 war. In this way, additionally, the creation of signalling and antibodies to target disease is being pursued in conjunction with prevention or the passage of the square infection has become a necessity in the fight against COVID-19 [1]. Regardless of the possibility, rapid transmission of genetic variants and development has greatly increased the global burden. Nanotechnology completes as an important asset with a potential for measuring pollution by playing a key role in anticipating, diagnosing, and COVID-19 prophylaxis processes. Nanotechnology and sanitizer protective procedures are among these techniques, tools with rapid, heart-clear, and transparent diagnostic tools and rehabilitation specialists or antibodies to transmit antibodies to the human body. As a rule, nano-matadium, for example, metal nanoparticles remain shorter in size one micrometre, bringing a higher surface-to-volume ratio. Nanomaterials also have better melting and more activation of effective drug transfer, as well as changes in quality like a positive correlation between target analysis and atomic retention in the nerves. Therefore, nanomaterials are highly focused on potentially playing a crucial function in managing the existing epidemic and prevent potential outbreaks [2].

METHODOLOGY

Nanotechnology will likely continue to contribute to the management of COVID-19-related issues, including the multiple health problems of 'long haul COVID' that develop more than three months after the acute infection. In the post-pandemic era, the application of nanotechnology is important in terms of global preparation for future viral pandemics. In this review, we discuss the role of nanotechnology in the diagnosis and treatment of COVID-19 and its role in the post-pandemic era. We discuss nanotechnology as applied to the detection of SARS-CoV-2, vaccine development and the development of antiviral medicines. From there, we discuss the role of nanotechnology in the post-pandemic era and highlight nanoscale information in the battle with SARS-CoV-2 variants and the global distribution of vaccines [3]. Finally, we present our perspectives on nanotechnology for the management of viral diseases, considering the lessons learnt that will inform the management of future pandemics, in terms of

***Correspondence to**: Anisimov Roman, Department of Networks and Information Security, Faculty of Information Technology, Al-Ahliyya Amman University, Amman, Jordan; E-mail: Romananisimov@edu.com

Received: 03-Jan-2023, Manuscript No. Jnmnt-23-19580; **Editor assigned:** 05-Jan-2023, Pre QC No. Jnmnt-23-19580 (PQ); **Reviewed:** 18-Jan-2023, QC No. Jnmnt-23-19580; **Revised:** 25-Jan-2023, Manuscript No. Jnmnt-23-19580 (R); **Published:** 31-Jan-2023, DOI: 10.35248/2157-7439.23.14.657.

Citation: Roman A (2023) Role of Nanomaterial of SARS-CoV-2: Prevent, Diagnose and Treat COVID-19. J Nanomed Nanotech. 14: 657.

nanotechnology for prevention, diagnosis and treatment.

ROLE OF NANOTECHNOLOGY IN COVID19 DIAGNOSTIC

Atomic tests are much more obvious than CT filters to get precise conclusions because of their visible pieces of evidence. Serology testing is another way to deal with SARSCoV-2. In particular, detection of specific antibodies alongside the corona virus spike proteins is preferable. Diagnosis contributes significantly to the construction of the barrier of COVID-19, which limits its distribution by understanding ID and disconnection. While a number of diagnostic methods have been introduced, promoting critical and rapid testing of COVID-19 symptoms remains a challenge. Chest modernized tomography filters and atomic tests were used to evaluate and diagnose COVID-19. The serological research center explores and rapid testing projects have reached out to corona virus. Although in vitro experiments are basic and successful, they have shown problems within diagnosis of corona virus owing to the regulation of infectious diseases based on mutations. Various nanomaterials are currently used in the area of infection detection [4]. Both nucleic corrosive and protein diagnostic techniques are less sensitive to knowledge, for example, genomic and proteomic formation of a microbe or protein quality adjustment in the host when contaminated. Proteomics and genomics of SARS-CoV-2 have been detected as of March 2020; however, the response to SARSCoV-2 assays is still being developed for this disease. One of the most extensively utilized nanomaterials for fast diagnostics is gold nanoparticle. Similarly, a specific measurement of colorimetric hybridization was employed to differentiate SARS-CoV-based dsDNA based on ssRNA. For example, nanoparticles of gold have been used to classify waste DNA for specific disorders, such as cancer. Specifically, in the AuNP environment, single-stranded RNA or DNA can interact with citrate particles and salt expansion can resolve particles and modify the tone. These structures interact with the immune response, which brings about absorption and changes of dignity, enabling the effective diagnosis of COVID-19. In another study, a successful protein-binding process was performed on the outer layer of Au using Au-restricting polypeptides. The Aurestricting polypeptide complex protein and AuNP nanopattern protein did not move to the refined raw luminous antigen, corona virus antigen E, and specific antigen pattern [5].

A range of nanoparticles, including colloidal gold nanoparticles, quantum dots (QDs), rare earth nanoparticles, magnetic nanoparticles, carbon nanotubes and hybrid nanoparticles such as QD-doped mesoporous silica nanoparticles, can be used in immunoassays to detect various targets. The tests can be used with nasal swabs, throat swabs, sputum samples, saliva samples or serum. There are 49 US FDA-approved antigen diagnostic devices for COVID-19, as of 28 May 2022, under emergency-use authorizations. Most of these diagnostic devices are LFA that use colloidal gold nanoparticles or QDs. In immunological assays, various nanoparticles are conjugated with antibodies, to either reveal a visible colour change or to allow fluorescent/electrochemical/ magnetic signal detection when the conjugated antibody has bound to the antigen. Colloidal-gold-nanoparticle-based LFA is the most common one, with the advantages of low cost and a simple result-reading method (just by sight; no instrument is needed. The fluorescence-based detection method uses fluorophores such as QDs and rare earth nanoparticles and offers higher sensitivity and a lower detection limit compared to colourimetric detection. QD-based fluorescence assays can achieve sensitivity at least 10 times higher than gold-based ones due to the lower background and higher brightness. However, special fluoresce reading instruments are needed for the results reading [6]. The strategy of using a smart phone's camera with a simple light source may provide a cheap and simple method of fluorescence-based detection. Magnetic LFA provides another strategy for antigens tests, by measuring the stray field changes from the magnetic nanoparticles. These methods offer very high sensitivity and low detection limits due to no or negligible background noise. However, special instruments such as giant magneto resistance sensors are needed for the detection and are thus not widely used yet. Recently, hybrid nanoparticles such as QD-loaded mesoporoussilica-based LFA could improve detection sensitivity by 104 times compared to commercial colloidal-gold-based LFA, and thus may be used for early detection of SARS-CoV-2 infection [7].

ROLE OF NANOTECHNOLOGY IN COVID19 TREATMENT

Antiviral drugs have been tried at the beginning of the COVID-19 trial, for example, lopinavir, chloroquine, remdesivir, ritonavir, and rakuvirim, and have shown promising results against SARS-CoV-2. The main barriers to current antiviral treatment are ineffective diagnosis, which leads to cell cytotoxicity. Nanotechnology lays down some freedom for antiretroviral therapy. The prevalence of new diseases and their variability require novel treatment. The flexibility of nanoparticles makes them readable vectors for the clear transmission of regenerative drugs and focused infection. How to use nanoparticles to fight SARS-CoV-2 can contain systems that contribute to the transmission of infection to the host cell until it is inactive. Inhibition of excess viral protein may result in death of the infection, so focusing on nanoparticles, which are specific to the proteins transmitted by infection, and may reduce viral secretion. Natural nanoparticles have been used in the transmission of antimicrobials, such as acyclovir, zidovudine, efavirenz, and dapivirine, to enhance drug bioavailability, drug transfer, and prescribed antiviral action [8]. Stained nanocomposites and metal nanoparticles are known to be effective against diseases and organisms due to their irresistible properties, as well as the ability to control the arrival of particles. For example, the arrival of controlled metals, for example, Ag, Fe, Cu, Zn, TiO2, CdS, and MnS2, has shown antimicrobial properties and antibacterial properties of metal united GO. Nanotechnology can assist in the development of COVID-19 drug delivery due to the benefits associated with nanoparticle morphology and licensing for the transfer of drugs to inaccessible areas without stimulating the unresponsive reactions of retinal endothelial cells. The surface-to-volume component enhances drug accumulation of the nanoparticles limit crossing layers by contrasting charges due to their surface charge change and the nanoparticles such as silver and their innate AuNPs viracidal movements, and current therapeutic nanoparticles for CoVs are summarized [9]. These applications rely on their ability to escape incomparable confession, rapid corruption, and some sad zeta power for long-term transmission through the body and small size forcing tissue penetration. Corrective protection and efficacy of exosome transfer to the target cell have now received more than usual consideration. A few clinical applications have been introduced as potential nanoorganic carriers in the treatment of COVID-19. These exosomes are then transported to the target tissue; however, different methods can be used to create discretionary exosomes that include rotating design methods and direct design methods. In circular design, a few cells, for example, indistinguishable organisms are refined by auxiliary technicians or genetically modified to make artificial exosomes and drugs, while in rapid design, recycling technicians are packed directly into isolated exosomes from source cells. Truth be told, there are three stages in their creation from the endocytic cell pathway, the formation of endocytic vesicles through plasma invagination film, the internal growth of the previous endosomal barrier, and conversion of MVBs by plasma layer to form exosomes [10].

RESULTS

With several highly effective COVID-19 vaccines deployed at scale in many countries, an important question is whether the use of nanotechnology in vaccines provides the necessary ability to rapidly redesign vaccines when concerning variants appear that are more virulent. Outlined below are the major advantages of mRNA delivered in lipid nano-carriers.

CONCLUSIONS

Nanotechnology has empowered the global response to the COVID-19 pandemic, through powerful tools for prevention, diagnosis and treatment. Detection systems based on nanoparticles and nanopores have enabled rapid and inexpensive detection of the virus, and have informed public health measures. One lesson we have learned during this COVID-19 pandemic is that rapid, large-scale virus detection can greatly help disease control and requires the development of virus detection methods that are simple to use, and have high accuracy and low cost. The power of nanotechnology-driven detection such as the LFA and nanopore sequence can be further explored to manage COVID-19 and other potential virus diseases.

During this pandemic, lipid nanoparticles for delivering mRNA in vaccines have played a major role in population-level vaccination strategies, and will likely play an increasing role in the future, both as a platform for the rapid development of vaccines, and for updating vaccines to address viral mutations. New nanoparticles with higher antigen-delivery efficiency, better stability, especially thermal stability, and target delivery are desired for vaccines. This ability to adjust to the challenges posed by a rapidly mutating virus is a major advantage of nanotechnology. Nanomaterials that have potent antiviral actions also have considerable promise.

In the long term, nanotechnology will serve as a technological foundation for the prevention and management of future viral-infection pandemics. Appreciation of the opportunities that nanotechnologies offer is necessary for effective collaboration between scientists, policymakers and health care professionals when addressing the long-term challenges caused by SARS-CoV-2 and potential virus outbreaks.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest to report regarding the present work.

REFERENCES

1. Miller MA, Pisani E. The cost of unsafe injections. Bull World Health Organ. 1999; 77(10):808-11.
2. Alkilani AZ, McCrudden MTC, Donnelly RF. Transdermal drug delivery: Innovative pharmaceutical developments based on disruption of the barrier properties of the stratum corneum. Pharmaceutics. 2015; 7(4):438-470.
3. Scheuplein RJ. Mechanism of percutaneous absorption. II. Transient diffusion and the relative importance of various routes of skin penetration. J Invest Dermatol. 1967; 48(1):79–88.
4. Kirby M, Hutton ARJ, Donnelly RF. Microneedle Mediated Transdermal Delivery of Protein, Peptide and Antibody Based Therapeutics: Current Status and Future Considerations. Pharm Res.2020; 37(6):117.
5. Tuan-Mahmood TM, McCrudden MTC, Torrisi BM, McAlister E, Garland MJ, Singh TRR, et al. Microneedles for intradermal and transdermal drug delivery. Eur J Pharm Sci. 2013; 50(5):623-637.
6. Chen M, Quan G, Sun Y, Yang D, Pan X, Wu C. Nanoparticles-encapsulated polymeric microneedles for transdermal drug delivery. J Control Release. 2020; 325:163-175.
7. Oh SJ, Jung JH. Sustainable Drug Release Using Nanoparticle Encapsulated Microneedles. Chemistry - An Asian Journal. John Wiley and Sons. 2022.
8. Hong X, Wei L, Wu F, Wu Z, Chen L, Liu Z, et al. Dissolving and biodegradable microneedle technologies for transdermal sustained delivery of drug and vaccine. Drug Des Devel Ther. 2013; 7(1): 945–52.
9. Miyano T, Tobinaga Y, Kanno T, Matsuzaki Y, Takeda H, Wakui M, et al. Sugar Micro Needles as Transdermic Drug Delivery System. Biomed Microdevices. 2005; 7(3):185-188.
10. Larrañeta E, Lutton REM, Woolfson AD, Donnelly RF. Microneedle arrays as transdermal and intradermal drug delivery systems: Materials science, manufacture and commercial development. Elsevier Ltd. 2016; 104(2): 1–32.