CORRESPONDENCE

State of the Art Nanotechnology to Combat Current COVID-19 Outbreak

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ABSTRACT

COVID-19 has lately emerged as the most severe pandemics of the 20th century, with lethal consequences and a higher rate of propagation. More than 6.3 million individuals have died around the world as of this writing (June 10, 2022), while around 11.9 billion people have been vaccinated worldwide by June 06, 2022.[1] Since no effective drug against COVID-19 has been approved to date, it highlights the crucial need for developing newer therapeutic targets, vaccines, and antibodies to eliminate COVID-19 viral load and associated side effects.[2] Though, delivering these agents in a tailored manner that avoids off-targeting and excessive drug absorption is extremely difficult. It is commonly known that nanotechnology-based drug delivery systems improve conventional therapies, up till now, their application in viral infections remains underdeveloped and underutilized, as seen by the COVID-19 epidemic.[3] Nanotechnology enhances the pharmacological properties of drug by allowing the use of nano-systems such as organic (micelles, liposomes, polymers) and inorganic (metallic, quantum dots, carbon nano-tubes) nanoparticles for encapsulation. Nanotechnology has the high potential to combat against COVID-19 in a number of ways, for instance, prevention of viral contamination by spraying and developing personal protective equipment (PPE), as well as developing appropriate antiviral disinfectants.[4] Numerous nanocarriers have been used for drug delivery to address issues such as inadequate solubility, permeability, and target ability, all of which contribute to drug molecules failing to exert the desired therapeutic impact.[5] To identify COVID-19 infection or immune response, various nanomaterials can be employed as extremely accurate and sensitive nano-based biosensors.[6] A nanotechnology research group at University of Georgia developed a rapid test based on optical sensors designed for COVID-19 detection in August 2020. In March 2022, they filed a patent application on rapid COVID-19 detection, using an optical nano sensor, developed based on human angiotensin-converting enzyme 2 protein (ACE2) functionalized silver nanotriangle arrays.[7] Nanomedicine possess several characteristics that can be used to accurately transport therapeutic agents to the target cells, and the specific ligand conjugated nanoparticle connects with epitopes of the virus, causing the virus to be inactivated and unable to enter the cells. As a result, nanomedicine-based techniques that target COVID-19 binding, entry, replication, and budding can be used to neutralize the infection.[8] A number of products based on nanotechnology, like nano-silver is on the market currently due to their ability to combat viruses. Remdesivir is one of nanomedicine's greatest accomplishments in the management of COVID-19 infection. Furthermore, plasmonic nanoparticles (silver, gold and their hybrid nanostructures) have anti-infective properties against COVID-19 and have been useful in the development of diagnostic assays. For this reason, nanomedicine has shown to be critical in combating the COVID-19 epidemic.[5]

Several nanocarriers have been explored in designing and delivering vaccines such as lipid nanoparticles be able to deliver mRNA into the cytoplasm which directly translate in to the target protein.[9] In 2020, UK regulators approved the COVID-19 mRNA encapsulated lipid nanoparticles based vaccine created by Pfizer and BioNTech for emergency use, followed by authorization of Moderna's vaccine.[10] Recently, both of these nanoparticle based vaccines have been fully approved by the FDA.[11] The licensing of the COVID-19 mRNA vaccines was unquestionably a huge milestone in nanotechnology. Currently ten innovative technologies based on lipid nanoparticles are in clinical pipelines for COVID-19 vaccines.[11]

In conclusion, nanoparticles may play a vital role in COVID-19 pathogenesis at several phases during viral entry. Nano-encapsulated drugs may also be more effective at triggering intracellular pathways that produce irreversible virus damage and limit viral transcription, translation, and reproduction.

Going forward, nanoparticle-based vaccines will play mounting role in enhancing vaccination outcomes against COVID-19. Scholars may use state-of-the-art nanomedicine as a platform to examine their involvement in managing the COVID-19 pandemic with greater efficacy.

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REFERENCES

1. Available from World Health Organization (WHO). https://covid19.who.int/ [Accessed on 13 June 2022].
2. Tavakol S, Zahmatkeshan M, Mohammadinejad MR, Mehrzadi S, Joghataei MT, Alavijeh MS, et al. The role of Nanotechnology in current COVID-19 outbreak. Heliyon. 2020; 15: 06841.
3. Uskoković V. Why have nanotechnologies been underutilized in the global uprising against the coronavirus pandemic? Nanomedicine. 2020; 15: 1719-34.
4. Varahachalam SP, Lahooti B, Chamaneh M, Bagchi S, Chhibber T, Morris K, et al. Nanomedicine for the SARS-CoV-2: state-of-the-art and future prospects. International journal of nanomedicine. 2021; 16: 539.
5. Wankar JN, Chaturvedi VK, Bohara C, Singh MP, Bohara RA. Role of Nanomedicine in Management and Prevention of COVID-19. Frontiers in Nanotechnology. 2020; 2: 589541.
6. Chen L, Liang J. An overview of functional nanoparticles as novel emerging antiviral therapeutic agents. Materials Science and Engineering: C. 2020; 112: 110924.
7. Yang Y, Murray J, Haverstick J, Tripp RA, Zhao Y. Silver nanotriangle array based LSPR sensor for rapid coronavirus detection. Sensors and Actuators B: Chemical. 2022; 359: 131604.
8. Vahedifard F, Chakravarthy K. Nanomedicine for COVID-19: the role of nanotechnology in the treatment and diagnosis of COVID-19. Emergent materials. 2021; 4: 75-99.
9. Wang F, Kream RM, Stefano GB. An evidence based perspective on mRNA-SARS-CoV-2 vaccine development. Medical science monitor: international medical journal of experimental and clinical research. 2020; 26: e924700-1.
10. Editorial. Lasting impact of lipid nanoparticles. Nature Reviews Materials. 2021; 6: 1071.
11. Mohammed, Sameh A. and Shaaban, Esraa Ibrahim A. "Efficacious nanomedicine track toward combating COVID-19" Nanotechnology Reviews. 2022; 11: 680-98.