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Influence of nanotechnology to combat against COVID-19 for global health emergency: A review

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ABSTRACT

Covid 2019 is spreading and emerging rapidly all over the world as a new social disaster. This virus is accountable for the continuous epidemic that causes severe respiratory problems and pneumonia related to contamination of humans, which leads to a dangerous condition of life. Due to the increasing threatening number of cases all over the world, the world health organization (WHO) declared coronavirus as a global health emergency. The pandemic disease affected nearly 80 million people positive cases were reported worldwide till now and cause the death of more than 1.7 million people. The virus has novel characteristics types of pathogens. Many clarifications are done and much more are still unknown and pending. The collaborative research will be useful during this pandemic time in order to meet the improvement of global health improvement. It will also help to know about the knowledge of this COVID-19. Recent advancements in nanotechnology proved that they can help in the production of vaccines in a brief timeframe. In this review, the requirement for quick immunization improvement and the capability and implementation of nanotechnology combat against coronavirus disease were discussed.

1. Introduction

The worldwide health framework comprises a system of associations that includes numerous private and general health divisions working at various provincial or worldwide levels that have built up a stringent structure that can protect the people effectively against rising and re-emerging maladies. Although mortality related to different irresistible ailments have diminished currently and the worldwide future has expanded in numerous parts of the world even though the danger of this pandemic disease still remains as one of the major worldwide difficulties and concerns still now as the most important and overall task even today [1]. The emerging microbes which are Zika, Chikungunya, MERS and SARS, influenza are responsible for the increasing assortment of contaminated diseases [2].

Coronavirus is an outbreak disease which was first emerged in Wuhan City, Hubei Province, China [3]. Most of the nanotechnology licenses on coronaviruses have focused on the diagnostics, vaccines, and treatment procedures against sickness due to these contaminations [4]. Human coronavirus (HCoVs) is a critical social threat that is acknowledged as respiration microbes related to lung and abdominal impurities and pneumonia. The beta coronaviruses, a Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) first emerged in Guangdong Province, China in 2003. Also, the Middle East Respiratory Syndrome Coronavirus (mers-CoV) diseases erupted in 2012 in the Middle East and realized high pathogenicity to individuals, who showed the contamination once. This virus has been transferred from animals species to humans. These two
diseases were acknowledged to be evoked from bats and right now are transferred to individuals (Fig. 1), [5].

Sustainable development is a new concept to play a vital role in the growth of societies [6]. Reasonable economic loss on one hand of the scale and the improvement in air quality on the other may fundamentally affect the future plan of this world [7]. The COVID-19 is one of the most genuine difficulties since there has not been a lot of investigation concerning this issue [8]. Even though the comprehension of COVID-19 is constrained, a breakthrough in research facility bio care was presented by the WHD [9]. As a result of their outcomes, they made a few suggestions for avoiding more causes of this infection. The Hubei territories in China have opted to environmental for some significant elements such as temperature, wind speed, etc. The outcomes of the results were showed the relative stickiness and most extreme day by day high temperature had the strongest effect on the affirmed cases [10]. Having topographical nearness and a high volume of exchange with China, Vietnam was relied upon to have a high danger of transmission. More than 1,123,024 individuals have been tainted with more than 59,140 lives lost on April 4, 2020, as per the Global COVID-19 Tracker Map at John Hopkins University [11].

The fast virus spread and seriousness of the new illness have incited World Health Organization to refresh its articulation, structure characterizing the flare-up as a ‘General Health Emergency of International Concern’ on January 30 to a ‘Pandemic’ on March 11 [12]. In worldwide, over 80,675,736 people were infected, and 1,764,185 people died from coronavirus. The coronavirus affecting people considering the wonder of pre-lockdown alarm purchasing, in force in the United State, yet also to certain different nations, for example, France or Germany, nourishment instability and product lack have become genuine concerns. The social reaction can be seen from different gatherings, including private, business related, and casual gatherings. In enormous urban communities, places of business look measure to keep from the infection such as by disinfecting the entire structure or checking individuals’ temperatures, safety measuring. This part of the asset justifies as much consideration from the governments [13].

Fig. 1. Origin and transmission of coronavirus. Reprinted with permission from Ref. [28].
1.1. Viral nanoparticles

Viral contaminations are one of the main sources of dreadfulness and mortality in worldwide and which is one of the main purposes behind the huge economic losses [14,15]. Viral particles are the most tolerant and smart nanoparticles because it has in every case excitedly featured their basic attractive feature of nanoscale and their organic progeny in moving their hereditary substance into target cells and grab them to express of proteins. Table 1 shows that infections are transformative attraction and in the fields of quality treatment, vaccine, and immunotherapy (to give some examples), researchers are engineering and utilizing viruses for smart delivery of molecules and hereditary data [16].

2. Transmission of COVID-19

At present Covid-19 diseases are mostly spread through the direction of respiratory tract. An on-going report shows that SARS-CoV-2 diseases can be spread through the fecal-oral route. But still it is not sure that the route of transmission of infection and also (Fig. 1) still there is no proof that SARS-CoV-2 can be transferred across vaporizers or mother to infant in the prenatal period [27].

Frequently the human to human transmission occurs with the intimate connection. The transmission of disease first occurs through the respiratory droplets of different sizes (>5–10 μm in diameter) or when the contaminated individual coughs in the same way as the spread of flu and other respiratory pathogens. These droplets can settle in the entrance or indistinct mucosa and lungs by taking breaths in the air. At present, it is not clear whether an individual can be contaminated by COVID-19 by getting in touch with pollute the surface and subsequently touching their nose, mouth, or perhaps eyes [29,30]. Nanoparticles can benefit these pathogens even before they break into the body, as they clutch various objects and surfaces. The lab has created materials that can be spread on objects and enter into the structure of nanoparticles and attack the infections [31]. The target of this examination was to examine the effect of nanotechnology on COVID-19.

2.1. Origin and history of COVID-19 (global distribution of COVID-19 cases)

Towards the end of 2019, COVID-19 spread in a few nearby medical clinics in Wuhan, Hubei Province, China. Usually, the SARS-CoV-2 was insulated in natural examples of the Huanan Seafood Marker by disease control and prevention of CDC, inferring the source of the epidemic [2]. SARS-CoV-2 was first confined to three COVID 19 affected people from Wuhan Jinyin Hospital on December 30, 2019 [32]. All CoV are pleomorphic RNA infections naturally having peak form pepomers with a size in the range of 80–160 nm and 27–32 kb positive extremity. After a long year SARS this time, one of the more exceptionally pathogenic CoV has emerged in the Middle East countries [33].

Coronaviruses were provided their names based on the crown-like projection on their surfaces. The word ‘crown’ in the Latin language denotes ‘halo’ or ‘crown’. Human Corona Viruses (HCoV) were firstly described in the duration of the 1960’s in the noses of the patient with the regular virus. These are responsible to a greater extent to the normal virus. Two human coronaviruses are responsible for an enormous extent of common colds OC43 and 229E [3]. From the beginning, a pneumonia case was distinguished on December 12, 2019, and possible influenza and other coronaviruses were managed by inquiring about lab testing. Chinese experts have isolated the kind of coronavirus on January 7, 2020 (novel Coronavirus, nCoV) [29,34].

2.2. Classification of SARS-CoV-2

SARS-CoV-2 classifications are following [35].

| Family         | Coronaviridae |
|----------------|---------------|
| Subfamily      | Orthocoronavirinae |
| Order          | Nidovirales |
| Suborder       | Coronavirus |
| Genus          | Betacoronavirus |
| Subgenus       | Sarbecovirus (resemble bat coronavirus) |
| Species        | Severe Acute Respiratory Syndrome-related to coronavirus SARS-CoV-2 |

2.3. Coronavirus structure and shape

The principal reports of neuromuscular discoveries from extreme COVID-19 cases were demonstrated the pneumonic respective di-utilize alveolar injury with cell fibromyxoid exudates. The right lung was demonstrated the apparent desquamation of pneumocytes arrangement of hyaline membrane and showed suffering from breathing disorder [36]. COVID-19 was brought about by SARS-CoV-2 a beta coronavirus. It includes a solitary abandoned of Ribonucleic Acid (RNA) structure. Investigate the arrangement of SARS-CoV-2 has demonstrated a structure of normal to that of different coronaviruses (Fig. 2). The genome was connected with the SARS virus [37]. The run of the nonexclusive coronavirus genome is a solitary strand RNA, 32 kilobases long, and it's the biggest known RNA infection genome. Coronaviruses have the most elevated known recurrence of recombination of any positive-strand RNA infection, indiscriminately joining hereditary data from various sources when a host is polluted with different coronaviruses. At the end of the day, these infections transform and change at a high rate, which hinders indicative discovery and treatment (and immunization) regimens [38]. In people, coronaviruses were assumed to cause gentle respiratory diseases until the distinguishable proof of SARS-CoV-2 and MERS coronavirus (MERS-CoV) Table 2. Although the specific pathophysiological systems have hidden the development of SARS-CoV-2 (because of pending research facility preliminaries), genomic similarities to SARS-CoV could assist with clarifying the subsequent incendiary reaction that can be prompt the beginning serious of pneumonia [39].

Comparing these three coronaviruses, SARS-CoV-2 is very dangerous to people, and till it cannot be controlled, many death cases and researchers are struggled to identify the drugs against this virus and it’s created economic problems worldwide.

2.4. Symptoms

The transportation of 2019-nCoV is regularly spread from individual to individual through the breathing droplets and it is created for the period of hacks or wheezes from an infected individual. It is spread predominantly from human to human through the cough. It is yet obscure whether the infection spread uniquely through human contact. The hatching time changes from 2 to 14 days after contamination. The symptoms may include are following:

Very common symptoms are
➢ A fever
➢ A dry cough
➢ Fatigue

Rare symptoms are
➢ Body pains
➢ Sore throat
➢ Difficult to speak
➢ Conjunctivitis
➢ Diarrhoea
➢ Loss of flavor or loss of odor
➢ Headache
➢ Rashes on skin, or discoloration of toes or fingers

Severe symptoms
➢ Difficult to breathe or shortness of breathing
➢ Loss of speech or movement
➢ Chest pain or pressure

2.5. Diagnosis

In all, AI (Artificial Intelligence) is used to identify the track forecast outbreaks and it is helping to diagnose the virus. It is also utilized for preparing in medical care claims. The robots are utilized to convey food and medication supplies just as in sanitizing public spots. AI is assisting with creating drugs and COVID immunization utilizing great PCs [41]. Computerized reasoning can be portrayed as Machine Learning (ML), Natural Language Processing (NLP), and Computer Vision applications. These capacities are taught PCs to utilize immense data based on the models to configuration, portray, and foresee. The general pandemic of COVID-19 altogether challenges open clinical structures. With confined clinical resources, treatment needs are constrained by the seriousness of the patient. Computer-based intelligence limits can be significant to investigate, anticipate, and explain about the COVID-19 pollution and help it's to direct the economic impacts. Previously the most clinical uses of computerized reasoning are mostly a response to the COVID-19 and it is focused on finding reliant on clinical imaging [42].

Researchers were said the AI application shows that it can give an additional opportunity to radiologists and do a finding faster and more affordable than with Covid customary tests. For this reason, the specialists can utilize the X-ray just as CT examines and Computed Tomography [43]. Optical sensors incorporate SPR-based, colorimetric-based, chemiluminescence (CL) aptasensor, fluorescence, and SERS-based aptasensors methods were used. The CL aptasensor is quickly depicted here because of its application in the location of extreme intense respiratory condition of covid (SARS-CoV). Based on the biosensors the novel qualities of nanobodies were improved for example: little size, high strength and solvency, high partiality and explicitness against targets. Spike proteins of COVID - 19 can be an objective to create a high-liking nanobody. For this reason, a recombinant or local type of protein ought to be accessible to the inoculation of camels and making a vaccinated cDNA library. By utilizing Field Effect Biosensing (FEB) and a monoclonal neutralizer, which is covalently bound to graphene, a biosensor can be planned, for the identification of the Zika viral antigens.

The quantitative information can be gotten from the graphene stage, which is gives an appropriate instrument for both the symptomatic application and clinical investigation [44]. Advanced radiography on patients characteristically shows an obscure cavity like fix or diffused divergent airspace, practically identical to the next pre-detailed covid kinds of pneumonia (SARS and MERS-CoV). A test directed on
coronavirus patients demonstrated that 40 out of 41 patients have reciprocal lung inclusion in their chest electronic tomography (CT) scan [45].

PCR tests are for the most part acted in incorporated analytic administration by exceptionally gifted faculty and their results may take from 4 h as long as 3 days [46]. Nanomaterials are helped in scaling down the identification gadget by build-up the nanoscale stage, which is versatile, what's more, can accomplish for equivalent affectability of the complex instruments [47,48]. Business trials are furthermore not obtainable nowadays. In suspect cases in India, the best possible model must be to give the mention for the test centre in India or the National Institute of Virology in Pune. As the pandemic advances, the business trials will open up. The C-reactive protein (CSR) and ESR have assessed in the Institute of Virology in Pune. As the pandemic advances, the business trials may take rest [3]. WHO has suggested some drugs for reducing the growth of the virus. WHO Chloroquine, Hydroxychloroquine and some others drugs have been identified to control the virus.
development. Later the mainstream particles are disguised and go into endosomes. The low PH endosomes of viral particles are uncoated and the viral genome is discharged for protein association. Subsequent viral RNA and amalgamation of protein of novel irresistible particles are gathered and discharged (Fig. 5).

4.1. Ferrite nanomaterials related to COVID-19

Nanomedicine and biomedical experts have made conveyance structures used in dissimilar arenas, comprising dangerous development treatment and reformatory medication [62,63]. Nanoscale tools will most

| Status                  | Treatment          | Structure of component | Active                      | Free infection tools                                                                 | Achieve viruses                                      | Ref. |
|-------------------------|--------------------|------------------------|-----------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------|------|
| Accepted, Investigational, Examine | Chloroquine       | q-aminoquinolin        | Expanding endosomal pH, immunomodulating, autophagy inhibitors | Malaria, autoimmune disease                                                            |                                                      |      |
| Approved                | Ribavirin          | Synthetic guanosine nucleoside | Meddling with the union of viral mRNA | HCV, SARS, MERS                                                                     |                                                      |      |
| Approved, Investigational, Ganciclovir | Nucleoside analog | Intense inhibitor of the Herpesvirus family including cytomegalovirus | AIDS-associated cytomegalovirus infections                                             |                                                      |      |
| Approved, Investigational, Nitazoxanide | Antiprotozoal agent | Moderating the endurance, development, and multiplication of scope of extracellular protozoa, helminths, anaerobic and microaerophilic microbes, infections. | A wide scope of infections including human/creature coronaviruses                      |                                                      |      |

Fig. 3. Components of personal protective equipment (PPE). Reprinted with permission from Ref. [56].

Fig. 4. Cleaning of personal protective equipment (PPE). Reprinted with permission from Ref. [56].

Fig. 5. SARS-CoV-2 virus life cycle and nanomaterials potential target. Reprinted with permission from Ref. [61].

Table 4
List of potential antiviral drugs to different virus diseases.
allow watching to investigate and to act across the completed condition of a switch to help noticing either a fix or reducing strategies for COVID-19 and observing of SARS-CoV-2 [64]. The outstanding antimicrobial features of definitions and nanomaterials such as silver, copper, and zinc species [65,66] are combat against COVID-19 and protect from the infection and diseases. Silver nanoparticles are having highly antiviral movement. They are going about as for viral multiplication inhibitors, and their various veridical developments upon the objective disease. For example: the AgNPs can prevent the viral area in cells, because of the HIV-1 contamination, which was represented that AgNPs can associate with cell receptors. In this way, gold nanoparticles are balanced by biocompatible polymers exhibited to antiviral development against HIV-1 and few subcategories of influenza diseases. The AgNPs were represented of ability to obstruct the viral area in have cells by virtue of the HIV-1 contamination which was indicating that AgNPs can associate with cell receptors. The gold nanoparticles are settled by biocompatible polymers that have shown antiviral development against HIV-1 and few subcategories for influenza of contamination [67].

Nanomaterials ferrites are a class of delicate attractive materials that have excellent electrical, attractive, and optical properties. A ferrite is a material that is comprised of iron oxide (Fe$_3$O$_4$) and an enormous extent blended in with metallic components such as barium (Ba), manganese (Mn), nickel (Ni), zinc (Zn) to little extents. The idea of both the iron oxide and the metal is electrically non-leading and ferromagnetic. There are two kinds of ferrites are I) hard ferrites and ii) delicate ferrites. Hard ferrites making by a perpetual magnet are used to apply in the fridge, TV, clothes washer, etc. Delicate ferrites is a low coercivity, great conductor, it's a minimal effort, time, and temperature [68]. The current researcher endeavors are (both physical and chemical) concentrated the earth to explicit of antiviral medications and physical remedial against COVID. In the future, we have to attempt to convert this note to how non-intrusive explicit molecular recognition through two principle tests 1) a colorimetric examination for lab-quality discovery (Fig. 7A), and 2) electrochemical measures for nucleocapsid protein location (Fig. 7B). The colorimetric measure included the capacity of AuNPs to absorb specifically ssDNA over dsDNA and which was senses explicitly the existence of DNA object [74]. In the electrochemical measurements, AuNPs are used to upgrade the terminal conductivity and increment the surface area accessible for discovery test immobilization [75]. The high steadiness of the manufactured ITO/AuND/AuSP nanoprobe might be because of the way that there are no biomolecules consolidated in the detecting grid [76]. AuNPs based colorimetric is a simple and extremely high influence for measurement of nucleic acid. The utilization of AuNPs for the discovery of different infections either consuming changed methodology or in synthesis with other detecting attributes of Au NPs [71].

The perceivable instrument of AgNPs is rising the question about the administration of viral disease to other potential antiviral action [78]. A few studies are reported the AgNPs exposed the good inhibition of numerous infections, in particular, hepatitis B infection HBV [79], flu infection [80], human parainfluenza infection type 3 (HPIV-3) [81], vaccinia infection [82]. GO (Graphene oxide), is a marvel material with uncommon electrical property that can be utilized for the advancement of the elite COVID-19 biosensing framework using such an explanatory stage [83].

SARS vaccine nano-delivery system is disclosed in the Korean patent where a SARS-CoV DNA vaccine (psi-S) encoding the spike protein was complexed with a polymer polyethyleneimine (PEI) for effective delivery of psi-S into cells. That intranasal immunization with PEI/psi-S nanoparticles stimulates antigen specified humeral and cellular immune responses [84]. Biopharmaceutical new advancements (BioTech) is a cutting edge in immunotherapy organization originating the novel treatments for cancer and different genuine illnesses. Because of its profound skill in mRNA antibody advancement and in-house producing capacities, quickly expanding losses of life of COVID-19 has been a reminder for worldwide wellbeing. At present not available no particular antiviral sources for controlling COVID-19. In this time among different fields of science innovation and nanotechnologies are can be a huge assistance for anticipation, analysis, and treatment of COVID-19. Using the anticipation method, nanofiber-based facial respirators, alongside nanotechnology-empowered profoundly compelling antimicrobial and antiviral disinfectants, have been the principal individual defensive
which implies that nanotechnology can forestall the spread of the infection; moreover, broad research is in progress to build up an immunization for COVID-19 based on various nanomaterials. In diagnostics, nanotechnology has demonstrated a significant guarantee in structuring sensors for growing brisk reaction of COVID-19 tests [85].

Webstar says iron-based nanoparticles could be guided with magnetic fields to target explicit organs in the body, for example: lungs and different susceptible to respiratory complications after contracting viral contamination. The looks into the nanotechnology-based coronavirus patent were showed that the President and Fellows of Harvard College head the top number of patents [86]. Sidelong stream innovation is utilized for the identification of proteins, viral antigens, and little atoms dependent on a progression of narrow beds such as pieces of nitrocellulose paper or microstructure polymer, that every one of these pads can ship liquid precipitously [87]. The CONVAT venture drove and composed by Prof. Laura M. Lechuga, revealed that the biosensor gadget will permit the examining the kinds of coronavirus present in repository creatures for example: bats to screen the advancement of these infections and prevent a future irresistible outbreak in human [88].

Despite the wide and over developing manipulation of new nano drugs, pharmacokinetic contemplations are exceptionally irregular, restricted and toxicological information, just as those concerning the discharge and the amassing of conceivably toxic side-effects are fragmentary. Again we need prescient strategies and endorsed conventions to examine the poisonousness of particles sorted out at the nanometre level, particularly in vivo models. Nano drugs share a few properties that are exceptionally valuable in inventive treatment: low fundamental harmfulness, dynamic particles, that can be captured in a shell while flowing. Much progressively significant is the capacity to damage the objective as harmed tissue, delayed arrival area of the medications [89].

The pandemic virus is still spreading among the people due to a lack of medicines to control the SARS-CoV-2 virus. Currently, some of the basic medicines are available to treat COVID patients such as chloroquine, hydroxychloroquine, etc.

5. Strengths, perspectives, and limitation of the study

Nanomedicines have been at the focal point of numerous scientists were concentrated on clinical preliminaries in recent days. Nanotechnologists are completing their social obligation to handle the progressing worldwide health emergency. There is a critical need to create quick analytic instruments and immunizations or post introduction.
prophylaxis to treat this contamination. A viable antibody ought to be reasonable and deliver appropriate immunization up-and-comers quickly at low cost, particularly outbreak the period of diseases.

6. Conclusions

Covid-19 is the most dangerous disease in worldwide. The number of people is affecting by a coronavirus in all countries. Many scientists are working to kill or reduce the coronavirus. Nanomaterials played a vital role in preparing PPE things like masks, sanitizers, gowns, etc. Even the researchers are trying to identify the viruses against coronavirus without any side effects. In this review, we have been focused on the nanomaterials combat with COVID-19 for diagnosis, treatment, vaccines, etc. Few current medications have been assessed for the treatment of COVID-2 and demonstrated promising outcomes in clinical applications. Further, as the information about SARS-CoV-2 is progressing, new antibody-including and monocular counteracting agents could be found in near future. We are given to attention for substantial approaches that deal with kinds of public health emergency in both short and long terms.

Declaration of competing interest

The authors report no conflict of interest.

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