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Use of Nanotechnology in COVID-19

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Abstract:

Nanotechnology is the creation of useful or functional materials, devices and systems by controlling matter on the nanometer length scale and exploiting new phenomena and properties that arise due to the nanometer length scale. Nanoscience is the study of structure and materials at the nanoscale. To give you an idea of the length of a non-meter when structures are small enough in the nanometer range, they can acquire interesting and useful properties. Nanomaterials are ideal for antigen release, act as adjuvant platforms and mimic viral structures. The first candidates launched for clinical trials are based on new nanotechnologies and are poised to make an impact. Nanotechnology clarifies the achievements of COVID-19 vaccine and therapy development to date through existing methodologies. At last, the applicable nanotechnology approach, based on nanomedicine, currently undergoing clinical trials, which has presented the potential to become innovative alternatives to overcome COVID-19 is described in detail.

Keywords: *Nanotechnology, COVID-19, Nanomedicine*

Introduction:

Nanotechnology ("nanotech") is the manipulation of matter at the atomic, molecular and supramolecular scales. Nanotechnology includes the synthesis, characterization, exploration, and use of nanostructured materials. Nanostructured materials are very interesting materials both for scientific reasons and for practical applications. The term "nanotechnology" was first used by Japanese scientists Norio Taniguchi (1912-1999) in a 1974 article on manufacturing technology that creates objects and features on the order of one nanometer.

Definite dimension nanotechnology is naturally very broad and includes fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, energy storage, microfabrication, molecular engineering, etc. Research and associated applications are equally diverse, extensions of conventional device physics to entirely new approaches based on molecular self-assembly, from developing new materials with nanoscale dimensions to direct control of matter at the atomic scale. "Scientists are currently discussing the future implications of nanotechnology. Nanotechnology can create many new materials and devices with a wide range of applications, such as nanomedicine, nanoelectronics, biomaterial power generation, and consumer products.

On the other hand, nanotechnology raises many of the same questions as any new technology, including concerns about the toxicity and environmental impact of nanomaterials and their possible effects on the global economy, as well as speculation about various apocalyptic scenarios. These concerns have led to a debate between advocacy groups and governments about the advisability of special regulation of nanotechnology.

The same also applies to macrosized materials. But when the particles acquire nanometric dimensions, the principles of classical mechanics can no longer describe their behavior (motion, energy, etc.). The principles of quantum mechanics apply to these dimensions. Therefore, the same material at the nanoscale can have properties (eg optical, mechanical, electrical, etc.) that are very different (even opposite) to the properties that the material has at the macroscale (volume) [1, 2].

The field of nanotechnology, by and large, is inexactly isolated into four subareas:

(i) micro and nanotools (ii) nanoelectronics

(iii) nanobiosystems and (iv) designed nanomaterials

The first addresses some of the broader but practical applications of miniature instruments for measuring atoms or molecules in chemical, clinical, or biochemical analysis; in biotechnology for the detection of agents; and environmental analysis.

The second category, nanoelectronics, refers to the development of systems and materials necessary for the electronics industry to go beyond current technological limits by producing details even finer than the characteristics of a high-performance microprocessor chip together with a new generation of plastic-based electronics. which is expected to create new markets with applications ranging from smart cards to tube-shaped computers.

The third class, nanobiosystems, can be described as the molecular manipulation of biomaterials and the associated miniaturization of analytical devices such as DNA, peptides, proteins, and cell chips.

The latest subarea, Nanoengineered Materials, examines several classes of advanced materials, including nanocrystalline materials and nanopowders used in electronics and photonics applications, as catalysts in automobiles, in the food and pharmaceutical industries, such as cell membranes. Fuel and polymer flakes for the industry. Nanotechnology engineering is a field of multidisciplinary engineering, which simultaneously takes advantage of and benefits from areas such as materials science and engineering, chemistry, physics, and biology. In fact, it is about generating new solutions based on manipulations at the atomic and molecular scale.

One of the biggest challenges facing the world today is the defeat of Covid-19. Nanotechnology is being applied to the production of Covid immunizations, improved protective masks, all the more remarkable disinfectants, and better demonstrative techniques.

"Nanotechnology assumes a significant part in vaccine design," wrote the researchers, driven by UC San Diego nanoengineering professor Nicole Steinmetz. Steinmetz is also the founding director of the UC San Diego Center for Nano Immunoengineering.

Coronavirus Disease 2019 (COVID-19) Outbreak:

The novel coronavirus disease, labeled by the World Health Organization (WHO) as COVID-19, was first reported in Wuhan, China on December 31, 2019. Compared to previously identified coronaviruses, such as the coronavirus For the severe acute respiratory syndrome (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV), the COVID-19 death rate is substantially lower but more transmissible, as it has spread to more than 219 countries, has infected more of 103,528,000 people and has claimed more than 2,237,000 lives to date (Worldometer, February 1). As one of the revolutionaries of the last decade, nanotechnology holds great promise in offering innovative solutions to a wide range of problems related to the prevention, diagnosis and treatment of COVID-19, in which nanotechnologists undoubtedly play a key role and shoulder their social responsibility.

Slowing the Spread of COVID-19:

Delaying the spread of COVID-19 the current COVID-19 crisis does not mark the first time that nanomaterials have been noted for their ability to limit the spread of viruses. Polymer-coated surfaces containing metal nanoparticles such as copper can release metal ions known for their antiviral activity, and their use in some areas has already been suggested. The widespread nature of the COVID-19 crisis requires a corresponding widespread application of such measures.

Nanotechnology offers a safer alternative to using toxic chemicals as disinfectants in medical settings. Such coatings are much more affordable than other non-toxic sanitation measures, such as ultraviolet (UV) light irradiation. These nanomaterial coatings and alloys impart antiviral and antibacterial properties through the release of ions, which disrupt the functioning of living cells.

One of the main difficulties in dealing with COVID-19 is its resilience and ability to survive on various surfaces for long periods, often days and days. The beauty of a nanomaterial coating is that it can provide continuous protection after just one treatment. This is especially true if the material can be structured so that the release of ions is gradual. Self-sanitizing surfaces will come in handy even after the COVID-19 crisis is over.

Copper proved effective against poliomyelitis in the late 1970s and, more recently; it has been very useful in fighting another coronavirus, HuCoV-229E. The virus, which typically lives for about six days on a surface, becomes inactive in about 60 minutes on surfaces coated with copper alloys. The similarity between HuCoV-229E and SARS-CoV-2 suggests that copper nanoparticles and alloy coatings are a key factor that is slowing, if not stopping, spread. [3]

Neutralizing Antibodies:

Unlike vaccines, monoclonal antibodies provide immediate protection; therefore, the administration of purified monoclonal antibodies with neutralizing ability could be another treatment strategy for SARS-CoV-2. Currently, the development of effective neutralizing antibodies focuses mainly on the protein S immobilized in SARS-CoV-2. Two potent camelid single domain neutralizing antibodies against SARS-CoV and MERS-CoV isolated from lama can cross-react with SARS-CoV-2, disrupting the receptor binding interface. [4] Recently, it was confirmed that 47D11 humAb binding to RBD protein S can neutralize SARSCoV-2 infection [5]. The S309 antibody, also known as the SARS-CoV monoclonal antibody, also potently inactivates SARS-CoV-2 by acting on the S protein. [6] Therefore, the use of various monoclonal antibody cocktails, which can be targeted concurrently with those not listed -RBD and RBD, can be a good alternative for effective and safe COVID-19 prevention and treatment.

Treatment Using Virus-Like Nanoparticles:

Virus-like nanoparticles (VLPs) are capsids, which include virus-derived structural proteins and adjuvants. VLPs can generate an immunogenic epitope potential, resulting in increased immunogenicity. Furthermore, because VLPs are small, they can act as adjuvants and adjuvant switching can induce a much more efficient immune response than viruses [7]. As a result of intranasal administration of VLP using the influenza virus, VLP has been found to work like a vaccine by producing large numbers of T cells and antibodies that can induce various types of immune reactions to enhance immunity and prevent further infections [8].

Graphene derivatives (GD), together with metallic NPs, can effectively inactivate viruses [9]. The antiviral mechanism of GD involves electrostatic interactions, in which the negative charge on the coated surface of GD promotes their binding to positively charged viral particles [10]. When GDs are applied to viral antibodies using nanotechnology, they show excellent effects on rotavirus and influenza virus infections [11]. Furthermore, this feature of AG can also be applied to the prevention, diagnosis and treatment of SARS-CoV-2, according to recent studies [12]. Iron oxide nanoparticles (IONPs) have already demonstrated their antibacterial activity through many studies. It has also been approved by the US Food and Drug Administration (FDA) for the treatment of anemia due to the excellent biocompatibility of IONPs. The interaction between IONP and the SARS-CoV-2 protein S has been identified in recent studies and the possible antiviral activity of IONPs has been reported. Furthermore, the ability of IONPs to produce ROS can be applied to inactivate SARS-CoV-2 in the external environment [13].

Conclusion:

Accumulated advances in these virus-fighting nanotechnologies may play an important role in taking SARS-CoV-2 treatment and vaccine development to the next level. The boring COVID-19 pandemic, which has yet to be ended, is now moving in the direction of overcoming the virus step by step with the help of nanomedicine. Currently, several companies are moving away from traditional SARS-CoV-2 treatment and prevention strategies and are using nanotechnology to develop various types of vaccines and therapies and conduct clinical evaluations. For example, dexamethasones, a COVID-19 therapeutic agent that has been introduced through various nanoformules, have led to a major shift in the treatment of COVID-19. Therefore, nanotechnology and nanomedicine may be suitable alternatives to this shift in the research and development paradigm.

Nanomaterials offer the advantage of incorporating conventional antiviral or virus detection modes with new modifications unique to nano-sized systems. Leveraging the unique properties of nano-sized materials for COVID-19 detection and treatment will help provide immediate relief from the ongoing pandemic.

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