The Current Update of Vaccines for SARS-CoV-2

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INTRODUCTION

Cases of severe illness causing pneumonia and death were first recorded in Wuhan, Hubei, China’s capital, in December 2019. Soon afterward, the number of cases increased significantly, expanding across China and across the globe. The pathogen has been identified as a novel enveloped betacoronavirus RNA, generally referred to as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Figure 1), which phylogenetically closes to SARS-CoV (1-5). The coronavirus disease 2019 (COVID-19) outbreak has officially been deemed an international public health emergency by the World Health Organization (WHO) (4). Efficient human-to-human connectivity seems a precondition for the widespread dissemination of this new virus (1-5). COVID-19 has currently emerged in more than 200 countries, impacting nearly 1.8 million patients and endangering the majority of the world’s population (Figure 2) (1-5). It is widely accepted that vaccines are the most effective method for reducing infectious illness since they are more cost-efficient than medication and decrease morbidity and death without negatively long-term consequences, thus, the production of vaccinations for SARS-CoV-2 has started at major institutions and agencies throughout the world. In this study, we aimed to introduce the vaccine status for SARS-CoV-2.

SAR-CoV-2 STRUCTURE AND ITS RELATIONSHIP WITH VACCINE

Per SARS-CoV-2 virion has a diameter from 50 to 200 nanometres. Like other coronaviruses, SARS-CoV-2 has four structural proteins, classified as S (spike), E (envelope), M
(membrane), and N (nucleocapsid) proteins; the N protein comprises the RNA genome, and the S, E, and M proteins together shape the viral shell. The spike protein is responsible for helping the virus to bind and fuse with a host cell’s membrane (Figure 3) (8-11). Theoretically, based on the structure of SARS-CoV-2, there are 3 main approaches of vaccine developments including whole virus, subunit, and nucleic acid.

Vaccines basically offer a survival course for the immune system in identifying and organizing defences against disease-causing pathogens such as bacteria or viruses. When the body recognizes such microbes they will produce antibodies that label them for death, so these antibodies continue as sentries to be identified by the same tiny marauders for potential invasions. Other vaccinations teach the immune system by merely introducing immune cells not to the pathogens themselves, but rather to the proteins that the viruses or bacteria produce; plenty of such foreign proteins will therefore identify them as unwanted.

**VACCINES RELATED TO WHOLE VIRUS**

Live attenuated or inactive whole-virus vaccinations serve a classic vaccination technique. Codagenix employed viral deoptimization technologies to synthesize live debilitated...
vaccines, which are rationally designed. Codagenix’s technology enables several vaccine candidates to be rapidly developed against SARS-CoV-2, beginning with just the digital sequence of the viral genome. The SARS-CoV-2 genome was already available to the public only a couple of days after the viruses were initially isolated (12). Johnson & Johnson utilized Janssen’s AdVac® adenoviral vector, similar to their Ebola vaccine platform, and developed it in their PER.C6® cell line technology. Their innate immunogenicity and capacity to activate toll-like receptors (TLRs) such as 3, 7, 8, and 9 are a big benefit of entire virus vaccines (13). In addition, ChAdOx1 nCoV-19, studied at the University of Oxford, is a safe adenovirus as it was engineered to not develop in the human body and genetically modified to produce a protein like S protein of SARS-CoV-2 virus. The adenovirus produces spike proteins after it has been introduced into the body and this is the SARS-CoV-2 surface antigen. The body will respond against potential SAR-CoV-2 to the production of new anti-SARS-CoV-2 antibodies (14).

**VACCINES RELATED TO NUCLEIC ACID**

The idea of DNA immunization began with positive tests in mice demonstrating defensive immunity to influenza in 1993 but these findings have not converted into comparable findings in humans for decades. More recently, experimental modifications and formulations have enhanced the efficiency of nucleic acid in humans, with the hope that this strategy may potentially contribute to the first human nucleic acid vaccine approved. Several big pharmaceutical firms have developed applications for the SARS-CoV-2 nucleic acid vaccine. Inovio Pharmaceuticals, for example, is producing a DNA vaccine, while others are pursuing RNA vaccine networks, such as Moderna Therapeutics and Curevac. Inovio Pharmaceuticals launched preclinical studies against SARS-CoV-2 for the DNA vaccine which stimulates T-cells by delivering DNA plasmids containing the SARS-CoV-2 spikes (15). In contrast, after being introduced the genetic material like mRNA encodes a protein from the virus into the body, the immune cells in the lymph nodes receive these mRNAs as a blueprint to generate the appropriate protein. This protein is recognised as an antigen by the body and will generate antibodies to destroy it (16,17).

**VACCINES RELATED TO SUBUNIT**

For SARS coronaviruses, subunit vaccines depend on an immune reaction to the S-protein spike to avoid its docking with the host angiotensin-converting enzyme 2 (ACE2) receptor (18). A collaboration led by the Texas Children’s Hospital Center for Vaccine Research at Baylor College of Medicine has currently produced and evaluated a subunit vaccine composed solely of the SARS-CoV-2 S-protein receptor-binding domain (RBD) (19). Furthermore, the University of Queensland synthesizes virus surface proteins, allowing them possible to submit to the immune system (20). Clover Biopharmaceuticals produces a subunit vaccine composed of a SARS-CoV-2 S-protein trimerized employing Trimer-Tag® technology (21). In addition, Novavax created immunogenic, virus-like nanoparticles based on S-protein recombinant expression (22) meanwhile Vaxart purposes to produce vaccine candidates based on the reported SARS-CoV-2 genome and test them for their potential to elicit both mucosal and systemic immune responses in preclinical models. The mucosal immune responses should be of special concern, as coronavirus is mainly a respiratory tract infection (23).

**CONCLUSION**

Each of these vaccines can entail additional processing measures and standardized toxicology tests before sending a regulation package to national regulatory agencies and may begin clinical development. All procedures have advantages and disadvantages. Nevertheless, in the present pandemic and into the future, developing vaccines without having the enough time to consider thoroughly the health hazards might cause unwarranted drawbacks.

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