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Review Article

COVID-19: VARIANTS, VACCINES, AND ADVERSE REACTIONS

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ABSTRACT

Coronavirus Disease 2019 (COVID-19) not only jeopardized the health condition of humankind but also bruised the economy. Researchers found several dominant and predominant strains of the coronavirus and variants, in which B.1.1.7, B.1.351, and P.1 being the most prevalent. In all the variants of severe acute respiratory syndrome coronavirus 2, modifications occur in the spike protein deciphering variants that differ based on characteristics and properties such as the extent of virulence, severity of the disease, or probability of reinfection. The development of a vaccine against the pandemic causing COVID-19 is considered a major milestone in the history of vaccines due to the speed at which the vaccine was made. The vaccine against COVID-19 vaccines are classified under nucleic acid vaccines, protein-based vaccines, viral vector vaccines, and whole virus vaccines. At present, there are 22 vaccines approved under the category of emergency use authorization. COVID-19 prevention has been the main principle behind early vaccine availability, although none of the approved vaccine candidates have completed large scale clinical trials to evaluate the efficacy. This review presents a brief idea on types of COVID-19 vaccines, approved vaccines, and vaccine candidates under development.

Keywords: Vaccines, COVID-19, Immunology, Infectious diseases, Approved vaccines.

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INTRODUCTION

Coronavirus Disease 2019 (COVID-19) pandemic has created a whirlwind of fear not only among the vulnerable people in the society such as adults aging above 60, people with other underlying complications, and the economically backward class but also healthy and economically sound individuals [1,2]. Based on the severity, three categories of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) variants are seen, namely, variant of concern (VOC), variant of interest (VOI), and variant of high consequence. The variants that come under the category of VOC are B.1.1.7, B.1.351, B.1.427, B.1.429, and P.1.Variants coming under VOI are B.1.525, B.1.526, B.1.526.1, B.1.617, B.1.617.1, B.1.617.2, B.1.617.3, and P.2. In the present scenario, no SARS-CoV-2 variant has emerged to a state of high consequence [3]. So far, 22 vaccines have been authorized across several countries [2,3]. Few drugs such as hydroxychloroquine and remdesivir have been approved for Emergency Use Authorization (EUA) as desperate measures to fight COVID-19 [4,5]. Increased rates of immunization may prevent another wave of infection and might control seasonal outbursts [3,6-8].

COVID-19 IMMUNOLOGY

COVID-19 is an infectious disease that mainly affects the respiratory system and is caused by SARS-CoV-2 virus [14]. Countries across the world have made their ways to stop the spread of pandemic by setting up isolation wards, canceling large gatherings, shutting down travel, and by closing of schools temporarily [5,7]. Coronaviruses are spherical, single-stranded positive Riboxynucleic acid (RNA) viruses composed of matrix proteins. The name coronavirus is derived from the Latin word corona, meaning "crown" referring to the spike-like surface protein projections on the surface of the virus [1,9-13]. Numerous glycosylated-S proteins are present on the surface of CoV2 virus that helps in mediating viral entry by binding to the host cell receptor such as angiotensin-converting enzyme 2 (ACE2). Whenever the S protein binds to the receptor, a transmembrane protein serine 2 activates the S protein promoting the entry of virus into the cell. On the entry, the viral RNA is released into the cell, translation of the polypeptide from the RNA genome occurs, further replication and transcription through the cleavage of protein, and finally the complex assembly of replicase-transcriptase, after which the viral particles are released [14-18]. The S protein in CoV2 is highly regulated in receptor identification, attachment, and entry of virus into the host cells which represent an important target in the COVID-19 vaccine search [16,18]. As an emergency measure in response to the COVID-19 pandemic, the first trial in humans targeting the S protein was started on March 16, 2020 under the category of mRNA based vaccine [17,19-21]. In the process of developing a vaccine against COVID-19, the S protein and it's subunit (S1) which has the receptor binding domain is being frequently worked on as vaccine antigens as it has the ability to release neutralizing antibodies that can deny the entry into the host cell and thereby preventing infection [16,18,19].

KEY POINTS TO CONSIDER IN VACCINE DEVELOPMENT

To develop a potent and safe vaccine against COVID-19, few factors need to be considered about SARS-CoV-2 and its immune response against the vaccine and the infection [23,30].

Type of mutation

Several variants of SARS-CoV-2 have been reported globally in this pandemic. There are around 30,000 letters of RNA included in one SARS-CoV-2, which enables the virus to attack and replicate. However, these mutations are found to be slow and mild, and mutants nearly replicate similar sequences as in the parent strain providing us with a relief in the development of vaccines [22,23].

Immune response

Blood analysis of COVID-19 recovered patients have shown to possess antibodies against SARS-CoV-2 virus. Studies report that neutralizing antibodies may decrease or disappear after 3 months from recovery. Researchers need to focus on the strength and the nature of response of the vaccines toward the virus and its effect on the immune system [15,17].

Reinfection probability

Question seems to arise on how long any immunity can last if reinfection occurs. Concerns on the possible mechanism of reinfection in a person who has already been infected once before seem to hang