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Current Status of Potential Vaccine against COVID-19: Review

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Abstract

From many years, different viruses such as SARS-CoV2 have been a genuine threat to the world that wiped away thousands to millions people from the earth. Since the advent of viral diseases, vaccines have been proved as the ultimate solution to eradicate or prevent them from spreading to the larger population. Although it takes many of years to develop a potential vaccine, it is more effective in reducing viral spread. After the outbreak of SARS-CoV2, scientists around the globe are struggling to develop vaccines to stop its spread and help the people who are seriously ill. In this paper, we have evaluated current status of vaccine development to treat the virus under study.

1. Introduction:

In the history of mankind, many viral diseases caused pandemic and endemic around the world. The vaccine decrease complications and mortality risks due to infectious agent [1]. There are different strategies and designs to develop vaccine, which varies from diseases to diseases [2]. Therefore, it is important for researchers around the globe to develop vaccines in order to eradicate or prevent them from reoccurring in near future. In order to develop an effective vaccine, vaccine design is required to be more pathogenesis driven which should have the potential to target key virus molecules [3].

The most pathogenic and virulent virus which posed a genuine threat to humankind was the SARS-CoV, which belongs to *Coronaviridae* family in 2003 [4]. In December 2019, SARS-CoV2 (another most deadly corona virus) emerged in Wuhan city of China that initially spread from animal to man and then, from person to person [5]. Gradually, it spread throughout the world, and on February 11th, the World Health Organization (WHO) recognized the disease with name COVID-19 and announced the situation as a pandemic. Therefore, it became vital requirement for both secure and effective vaccines to stop its spread [6]. As a result, in this article, we have analyzed the developmental

condition of vaccines against the deadly infection by the virus in question.

2. Clinical trials:

Most of the study was undertaken the S protein of the corona virus, as it is accountable for binding to the receptor of host and also fusion of membranes of virus and host [7]. When the vaccine trials were conducted against SARS and MERS, the whole virion S protein was used, and in case of COVID-19 disease, it was dominated through the same antigen [8]. Development of a vaccine is top priority of COVID-19 pandemic. The trial in phase 2 was conducted in order to further examine not only immunogenicity but also safety of CoronaVac which is also called as a SARS-CoV-2 inactivated vaccine [15]. Authors reported that favorable immunogenicity as well as safety of CoronaVac was observed supporting the study of trial in phase 3 [15]. In the pre-clinical study on rhesus monkey by [9], it was observed that with 3 doses of inactivated CoronaVac vaccine, the monkeys got recovered completely.

In Jiangsu, China placebo-controlled, double blinded and two phase I/II trial was conducted to evaluate the security as well as SARS-CoV-2 vaccine immunogenicity which is inactivated in nature in healthy adults of more than 60 years or 18 or 59 years age [10]. The alum-adjuvanted as well as formalin-inactivated vaccines were used for trial [10]. The primary aim was to record the existence of adverse effects after the vaccination along the evaluation of immunogenicity [10]. Furthermore, in Shangqiu, China, a phase I/II, twofold blind, randomized, placebo-controlled phase I/II clinical trial was conducted for the evaluation of both safety as well as immunogenicity of SARS-Co-V2 (inactivated) in 3 years and older healthy individuals [10]. Shockingly, occurrence of adverse effects was reported as a primary outcome [10].

Adjuvants are used to increase efficiency of vaccines. Similarly, Matrix-M adjuvant which is made up of Quillaja saponins that was formulated with both cholesterol as well as phospholipids into nanoparticles, augments both Th1 and Th2 reactions, enhances trafficking of the cells of immunity, induces antibodies that belong to many subclasses and allows dose-sparing of antigen [16,17,18,19,20,21,22]. Fortunately, Matrix-M-adjuvant vaccines showed safety profile which was acceptable in clinical trials [23,24,25]. To add, Matrix-M showed well performance or better combination when used with influenza vaccines in mice [26,27]. Moreover, Novavax in Australia is investigating the immunogenicity along with the safety of a SARS-CoV-2 recombinant Spike nanaoparticle vaccine as well as devoid of Matrix-M adjuvant in fit members (131) with ages between 18 and 59 years old [10].

In order to investigate the efficiency of Bacillus Calmette-Guerin (BCG) vaccine against COVID-19, four trials were tested [10]. Multicenter, two-group, open-labeled randomized controlled trial (RCT), the first trial in Australia, the COVID-19 testing occurrence computed over the 6 months post randomization with 4170 estimated participated individuals enrolled [10]. In the Netherlands, the second trial was conducted with placebo controlled; adaptive multicenter RCT with estimated enrolled 1500 participants [10]. In this, the number of days in which healthcare workers were absent was measured [10]. Additionally, in South Africa, a phase III, double blinded, randomized trial was conducted with estimated 500 involved participants [10]. In this, incidences of hospitalizations of health care workers due to COVID-19 were measured [10]. At last, in United States, the phase IV with randomized and double blind trial was conducted that to test the occurrence of COVID-19 infection, and in this process, 1800 participants were engaged [10].

3. Vaccine manufacturing status:

The vaccine development is very complicated activity which combines interaction of host-pathogen at the molecular level along with the biomechanical requirements which help in understanding of selecting the adjuvants and also antigenic targets [1]. Different companies around the globe were taking the efforts to develop vaccines against COVID-19 (table 1). Vaccines were tested up to the second trials (table 1). From the study by Moderna Pharmaceuticals (Biotechnology Company) on mRNA-1273, it was found that the mRNA

under study was safe and tolerated by the lungs in the mouse model, using 2 lower doses 25 and 100 µg of the vaccine [11]. Moreover, the company has planned to work phase-II and phase III studies with dose amount ranging from25-100 µg RNA [11]. The Moderna mRNA reported to able to generate n-AB titers, but the results were not evaluated yet [12].

Even if the vaccines were being speedily developed, they will appear so late that they cannot affect the first wave of pandemic [13]. Time will speak what will be the result of clinical trials going on around the world, we are still uncertain about the fate of the virus [11].

Table1: Strategy and the race of 9 pharmaceutical companies around the world for producing vaccines against COVID-19[14]

Sr.no	Company name	Collaboration	Type of vaccine	Trial Stage	countries
1	Johnson & Johnson	Biomedical Advanced Research & Development Authority	Version of common cold virus to deliver a corona virus pathogen into cells to promote the immune system	Phase I	USA
2	Pfizer	BionTech (BNTX)	mRNA	Phase I	US/Germany
3	Moderna	National Institute of Allergy and infectious diseases, Lonza Ltd.	mRNA	Phase II	US
4	AstraZeneca PLC	Oxford university	Weaker version of the common cold virus with some genetic materials of SARS-CoV-2	Phase II	U.K
5	GlaxosmithKline	Sanofi	Combination of a technology that produce S protein found in SARS-CoV-2 with an immunological agent	Phase I	Uk,France
6	CanSino Biologics	Precision Nanosystem	Adenovirus S-vectored COVID-19 vaccines 2) mRNA	Phase I	China
7	Sinovac	Dynavax	Combination of Sinovac's chemically inactivated SARS-CoV-2 vaccine candidates with Dynavax immunological agent	Phase I	China/US
8	Novavax	N/A	Combination of Sprotein found in SARS-CoV-2 with company's nanoparticle technology	Phase I	US

4.Conclusion:

The development of vaccine against COVID-19 is a challenge to modern world and it may take time to release them in international market to eradicate the disease.

Author Contributions:

RD: Developed an idea, RB: Wrote the manuscript, KC: Collected the literature

Competing Interest:

Authors declare that no competing interest exists among them.

Ethical Statement:

Since it is review article, no ethical permission required.

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