

The COVID-19 vaccine race, vaccine immunity and vaccine herd immunity

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Abstract

The un-precedent down of corona pandemic and increments worldwide human death rates as well as thousands of diseased human subjects leaves tiny room for researchers to think about the real origin of Sars-cov-2. Where it comes from. The notable enormous tasks were mainly in two directions. First the search for promising vaccine technology saving human life pre-epidemic and during epidemics. The second, however, was centered around search for valid safe chemotherapeutics for saving life of the individual cases. The present communication aims at through a light on the current vaccine race, vaccine immunity and vaccine herd immunity. Governments, vaccine technologists, health science workers are being in a conquer to win the race and being the forerunners in manufacturing immune protective sars-cov-2 human vaccine. To date the in hand prepared vaccines are investigational in preclinical developmental phases and few of which reaching Phase I clinical trial. These scientific bodies and companies propose reach deadline vaccine development and production ranged from 9 up 18 months, though the scientific logic predict at least two to three years for that deadline.

Introduction

WHO announce at an early in 2020 that corona becomes pandemic? It leaves an increase numbers of deaths and thousands of diseased human subjects all-over the world [1]. The situation poses stimuli to make valid safe vaccine for human. Search institutes and scientific companies are being in a conquer to win the opportunity for developing and producing such vaccine [2-9]. To win the race in any conquer you must run fast to be in the fore front of the other runners. A case in which your being in high acquainted status. To be highly acquainted you should delineate the hallmark of your goal, putting it in relevant place then go ahead in application. The objective of the present communication at covid 19 vaccine race, vaccine immunity and vaccine herd immunity.

The virus

The electron micrograph that sars-cov-2virus morphology are being with round, elliptical or even of pleomorphic morpho-types with spherical symmetry. They are single positive stranded RNA viruses with crown like appearance due to the glycoprotein spikes on the envelope surface. The virus is sensitive to heat (to certain limits), UV, lipid solvents like ether 75%, ethanol, chlorine containing antiseptics and chloroform. The primary infection is thought to be starts from; Bats, Ant eaters (As a reservoir hosts) and raw sea foods on contact through such food consumption infection find port of entry to human. Though human to human cycle of infection is fairly demonstrated [10,11].

Genome and genomics

The genome structure of the sars-cov-2 virus is single stranded RNA. Its assembly as mRNA with 5 cap and 3 tail formation. The genome has 29891 nucleotide bases i.e., 30 kbs in length. This base sequence encodes for 9860 amino acids. On comparing with the bat SARS-like genomics it was found that of 89% similarity while human sars-cov-2 virus genomics have shown 82% similarity to bat SARS

genomics. The genomics structure of the sars-cov-2 consists of six open reading frames. Transcription work through replication-transcription complex RTC organized in double membrane vesicle and via synthesis of the sub-genomic RNA sequences. Transcription termination occurs at the transcription termination regulation sequences located between the forming ORFs [12,13].

Proteomics

There are six ORFs in the virus genome, of which the ORF number two to six are encoding for structural proteins like; spike protein, membrane protein, envelope protein, nucleocapsid protein, and the accessory proteins. While, the frameshift between ORF 1a and ORF 1b encodes for 16 non-structural proteins. Both structural and non-structural proteins are associated with virulence and pathogenic mechanisms of the virus. Spike glycoproteins composed of two subunits S1 and S2 as homo-trimer complex of the spike on the viral surface guiding them to the cell receptor. S2 subunit formed from a fusion peptide trans-membrane domain and cytoplasmic domain is highly conserved sars-cov-2 sequence with sars-cov. The trans-membrane helical segment in ORF1b encodes for two nonstructural proteins nsp2 and nsp3. Studies have indicated that there are viral mutations in nsp2 and nsp3 of sars-cov helical segment at the position723 glycine substituted by serine at sars-cov-2 and at position1010 isoleucine substituted by proline at sars-cov-2. Such mutations possibly explain the potential disease relapse. Around fourteen proteins types were mapped in corona virus proteome [14-18].

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Pathogenesis and pathogenicity

The port of entry of the virus can be eyes, nostrils, and mouth from there passes to throat, bronchus then finally to lungs. Lung cell become infected. Structural and nonstructural viral proteins take part as molecular virulence factors when the intracellular virion particles exceeds the infected cell volume and production of early and late viral proteins. The lung cellular damage happened through the action of activated immune cells producing an excessive IL6 amounts leading to the cytokine storm. A case which in turn induce immune tissue injuries in the lung tissue cellularity. Such immune events may initiate cytokine release syndrome which ultimately may terminated by multiple organ dysfunction and septic shock in the critical cases of human corona disease [10]. The pathogenesis and pathogenicity concept of sars-cov-2 virus infected human being is relative and conditional dependent on the host health state. There found somewhat a balance paradigm. Viremia may be followed by the extra pulmonary manifestation of the disease [10,11,19].

Balance/unbalance paradigm

In the infected host tissue microenvironment, when the immune mechanisms (Table 1), can be able to combats and balance the pathogenic effects of the sars-cov-2 virus, the host is being with no evident symptom and no pathology. But if the overall immune mechanisms, could not established the combating of viral virulence burden, the virus then will be able to escape such mechanisms leaving the infected host being in a weak state of immune system activities [10-14].

Corona vaccines

Vaccine is the attenuated or non-pathogenic version or their subunit components that have either preventive or therapeutic

potentials. Preventive vaccines are usable before epidemic arrival with mass application. While, therapeutic vaccines used during infection for individual infected welfare. It appears to be that the attempted for sars-cov-2 virus to date are live attenuated, molecular protein, RNA and DNA based vaccine in an adjuvanated and non-adjuvanated versions are currently under investigation.

There are, at least more than 70 prepared prototype vaccine candidates are in hands of researcher's all-over the world. Few of which are reaching the Phase I clinical trials. The expected deadline for having developed and manufactured licensed corona vaccine for human welfare spans at least between two to three years [20-22].

Corona vaccine technologies

There is several technologies known at work for developing corona vaccine though they are still in its infancy state [23]:

RNA based vaccine technology: SARS- COVID virus grown onto suitable laboratory scale, cellular culture system. Coronavirus growth induces its characteristic cytopathic effect. Growth collected, purified, and RNA extracted identified and purified. Purified mRNA preparation ratified concentration per unit volume to considered as a prototype vaccine candidate. This mRNA vaccine technology described as attractive and innovative, though there are some disadvantages (Table 2) [6].

DNA based vaccine technology: Recombinant DNA based onto the virus genomic sequence, the DNA version of the original virus RNA genome made published and distributed by china workers. To this end three trends may be operative. Of which the first, spike coding gene cloned into and expression system like yeast or other expression systems to produce luxury amounts of spike proteins to be purified

Table 1. The human host immune mechanisms during SARS-COVID infection

Component/mechanism [20]	Natural immune	Cross-road, immune	Adaptive immune
Complement	+	+	+
Interferon alpha	+	+	+
Opsonin	?	?	-
IL17	+	+	?
NK cells	+	+	?
Neutrophils	+	+	?
Macrophages	+	-	-
Antigen Presenting B cells	+	+	-
Activated Macrophages	-	+	+
Virus primed B Cells	-	-	+
Activated T cells	-	+	+
Virus specific antibodies	-	-	+
IL6 cytokine	-	+	+
Cytokine storm	-	-	+

Table 2. Laboratory developmental features of COVID 19 vaccine

Features [23-25]	mRNA vaccine	mRNA vaccine +adjuv.	DNA vaccine	DNA vaccine+adjuv	Spike S trimer vaccine
Understanding Disease	U	U	U	U	U
Understanding casual	U	U	U	U	U
prototype candidate	P	P	P	P	P
Lab.dev.					
Purity	Pr.	Pr.	Pr.	Pr.	Pr.
Lab.Dev.Safety	Safe	Safe	Safe	Safe	Safe
Lab.Dev.immunogenicity	WI	I	WI	I	I
Lab.Immune effectivity	?	E	?	E	E
Clinical Dev.Phase I	?	?	?	?	E

U=Understandable; P=Produced; Pr=Pure; I=Immune; WI=Weak Immune; E=Immune effective; ?=In question

4- BCG versus Covid-19.

and identified the ratified as concentration per unit volume and be a prototype vaccine candidate. Second, the spike coding DNA sequence cloned in an adenovirus and usable as vaccine candidate. While, the third trend is that by amplifying the specific sequence via linear DNA based vaccine with or without adjuvants. The developmental feature as in that of RNA based vaccine (Table 2) [6].

Protein based Vaccine technology: SARS-COV2 virus grown onto specific laboratory scale cellular culture system. Virus isolated purified, spike proteins are separated, collected in bulk, then identified. Concentration per unit volume ratified and be ready as a prototype vaccine candidate. Its developmental features as in Table 2. DNA and RNA COVID 19 vaccine prototypes are being of low immunogenicity adjuvants may enhance their effect. They are innovative and attractive, though it is difficult to obtain large number of doses [8].

Currently, I have received notification from Japanese society of vaccinology indicated a new trend of using BCG vaccine as an immune-prophylactant against covid-19 based onto studies conducted at Murdoch institute Melbourne. Researchers their state it is promising. Danish researchers also found similar findings.

Vaccine immunity

The corona vaccine immunity scenario can be ramified into; Mucosal and systemic vaccine strategies [24-27]. Immunity to corona mucosal vaccines may be started in the nostrils or throat, in which they constitute an inductive site where viral antigens taken up, presented and induce B lymphocytes to grow, proliferate and expand as an effector B lymphocyte migrate to lung tissue microenvironment where it home and secrete mucosal antibody specific to sar-cov-2 virus. The second part of the scenario is being through systemic vaccination where the virus vaccine pinocytosed, processed and presented to naïve B or naïve T to be activated and developed to B and T cells. The virus vaccine activated Th2 will activate B cells to grow, proliferate and expand as an antibody producing plasma and memory B cells. The activated Th1 will activate nonprime T cells to either memory or cytokine producing T cell. Immune cells producing IL6 will produce cytokine storm a sign of an immune tissue injury that might [might not depends on the intensity] follow the immunization. Mucosal response expected to be mounted within five days post-vaccination while systemic vaccination may mount within 14 days post-vaccination.

Herd immunity

Human or animal herd is a group subjects live in certain geographic niche in which they affect the environment and the environment, in turn, affect them. They also affect each other. Herd immunity as a concept is a general scientific theme and not confined to immune sense. The immune effect in the herd may be assembled from a total of major histocompatibility system, nutritional status, health status and the constitute of the immune system for the individuals forming the herd. The individual immune response to infection or vaccination are of tripartite nature as; low, moderate, and high. The overall herd immunity can be evolved from pre-immunity, past infection, past-vaccination, and/or current active infection cycle [28].

The theme of infection herd immunity

During this COVID-19 pandemic, Dec.2019 to May-2020 the Governments of the world countries at major perform general holds quarantine measures. however, the idea of considering the current infection cycle as sort of live replicative vaccine and tried to watch the layout of herd immunity operative events. A case which make the aged

and the chronically diseased aged people vulnerable to severe infection forms is mere an economic issue [28-30].

Concluding remarks

The virulence behavior of Sars-cov-2 virus within the infected persons is relative and conditional to the functional status of his immune system low herd responders got severe infection form, moderate responders may express moderate infection form and high responders contracts mild infection form. Age, nutritional status, limits of exposure, and layout personal health are the affecting factors to infection rates. Immuno-prophylaxis with vaccines still in its infancy state, though few of which reaching clinical phase I trials. Safe, immunogenic, inexpensive, noninvasive vaccine designs still in developing era. It needs at least two to three years to license for mass vaccination. Several scientific bodies and vaccine manufacturing companies with around 70 vaccine candidates assembled in five major technologies are being in a conquer to win the position of fore-front runners which of which will win the race. This is left for near future to say its classing word.

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