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Omicron Variant: Similar or Different Than Other Sars-Cov-2 Variants? Along With Significance of Nanomaterial in Omicron

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Abstract

WHO designated a new variant of COVID-19 on 26th of November, 2021 which is B.1.1.529 i.e. a variant of concern stated as "Omicron", on the advice of whose "Technical Advisory Group on Virus Evolution" (TAG-VE). TAG-VE made a decision on the basis of several evidence which is presented to them about the impact on how several mutations of Omicron behaves. Most commonly, the severity of illness it causes or how easily it spreads. The variant of concern (VOC) i.e., Omicron (B.1.1.529) variant of SARS-CoV-2 was detected firstly in South Africa but now it has been spread extensively on both regionally and globally. There are chances for Omicron variant to become dominant in the upcoming days or weeks, most probably due to increased risk of transmission. The very noticeable feature of Omicron variant is large number of spike mutations that possess a relevant threat to the potency of currently used Antibody therapies and COVID-19 vaccines. The Omicron variant is considered to be more infectious as it is at least three times more infectious than the original SARS-CoV-2 and so than the delta variant. The Omicron variant has been so far reported in 160 countries including territories. After scientific study, the newly spread Omicron variant is considered to be highly transmissible, even among the vaccinated people. Mucormycosis infection occurs mostly in unvaccinated individuals and people with vaccination have lower risk of getting infection. The review includes the study of the role of the nanoparticle for the omicron, omicron vaccine development, production, detection. The research even includes different methods of preparation of the nanomaterial in relation to omicron.

Keywords: *Omicron variant; B.1.1.529; Spike mutation; COVID-19; Mucormycosis; Nanomaterial; SAR-CoV2*

Introduction

COVID-19 is the disease caused by SARS-COV-2 it was firstly detected in 2019 in Wuhan city (China). COVID-19 is a severe case and has caused millions of deaths all around the world and it can be transferred from person to person [1]. The people who are down with COVID-19 will experience mild to moderate symptoms and some will become seriously infected and they may require the special medical attention [2]. The novel Corona virus which are known to infect or affect the human beings first detected in 2019 and it has been around for quite a time in animals and this Virus from animal crosses into the Humans. Scientist claims that this Virus is not new to the world but it is new to the Human beings and hence, Scientist named this virus as "NOVEL CORONA VIRUS" [3].

Most common type of symptoms of COVID-19 includes – Fever, Cough, Anosmia (loss of smell), Ageusia (loss of sense of taste) [4].

Omicron Variant

The variant of concern stated as Omicron (B.1.1.529) is a variant of SARS-CoV-2 which was first detected in South Africa, but now it has been spread extensively on both regionally and globally.

Table 1: *The comparison between different SARS-COV-2 Variants.*

Covid-19 Variants	Country Of Origin	Lineage	Spike Protein Mutations	Prevalence Of Analysed Sequences	Countries Or Territories Reported In
ALPHA	United Kingdom (UK), SEPT 2020.	B.1.1.7	11	<0.1%	197
BETA	South Africa, May 2020.	B.1.351	10	<0.1%	146
GAMMA	Brazil, November 2020.	P.1	12	0.10%	103
DELTA	India, October 2020.	B.1.617.2	10	99.80%	196
OMICRON	South Africa, November 2021.	B.1.1.529	32	Unknown	160

Data

Continents	Total Population	Confirmed Omicron cases
Asia	4.5 Billion	454513309
North America	583 Million	112791792
South America	424 Million	13040240
Africa	1.276 Billion	64396025
Europe	746 Million	371324005
Graphical representation of different COVID-19 variants.		

There are chances for this new variant to become dominant in the upcoming days or weeks due to increased risk of transmission. The Omicron variant has 32 spike mutations out of which ten mutations are on the key protein's i.e. (ACE-2 receptors) that helps the virus to spread the infection in humans. Although, the Beta variant has three mutations on the ACE-2 receptors and the Delta variant has two mutations [5]. This newly designated variant has been so far reported in 160 countries and territories like South Africa, Botswana, Austria, United Kingdom, United States, Israel, Hong Kong, New Zealand, Japan, China, India, Zimbabwe and many more, etc [6]. The fifth variant of concern i.e., Omicron emerges at a time when Vaccine immunity for previous variants is increasing in the world [7]. The Omicron variant can be transmissible among both vaccinated and unvaccinated individuals [8]. In USA, the Omicron case counts reached the higher records i.e., 4-5 times more than the previously detected variants of SARS-COV-2 [9]. The Omicron can be transmitted primarily via direct, indirect or closed contact with the fluid like respiratory secretion droplets, saliva of infected person when coughing, sneezing or talk. Although, other routes for the transmission are - faeco-oral route, mother-to-baby, and Animal-to-human beings' transmission [10].

Global

The Omicron Infection has crossed over approximately 330 million worldwide and the global death due to Omicron reaches to 5.5 million according to "John Hopkins University" [11]. There are various questions arising concerning the Omicron variant, they are -

Is the Omicron variant more severe than the other SARS-COV-2 Variants?

Preliminary reports suggests that the risk of hospitalization for Omicron is less as compared to the other variants. However, increased transmission may be expected which may lead to hospitalization [12].

According to the Head of WHO (World Health Organization), the highly infectious variant of COVID-19 which is Omicron causes the less severe disease when compared to other variants and it will remain as "Dangerous virus" for the unvaccinated individuals.

Why has Omicron spread so rapidly?

The rapid expansion of Omicron is because of some of the mutations on the spike protein allow the virus to break out the existing immunity from vaccination or earlier infection. The studies on animals reported that Omicron is more preferable to multiply in the upper airways like Nose and Throat rather than lungs [13].

Do Monoclonal Antibodies work against Omicron?

Woefully, most of the Monoclonal Antibodies which are used for the treatment of COVID-19 infection are ineffective against this Omicron variant of Corona virus. The only Monoclonal Antibody available for effective treatment of Omicron is "SOTROVIMAB" known by the Brand name – "XEVUDY" [14].

How is Omicron different from the other variants?

The brief description of the different variants available with its country of origin, lineage, and prevalence is described in (Table 1), followed by (Figure 1) [15].

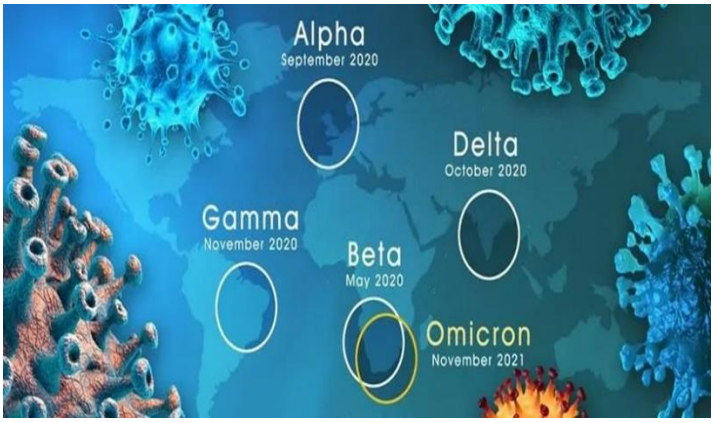

Figure 1: *Different SARS-COV-2 variants.*

Signs and Symptoms

The majority of signs and symptoms associated with Omicron variant are Common cold including –Headache, Fatigue, Sore throat, Runny nose, Sneezing 4 and Extreme tiredness, Low Oxygen level Anosmia and Ageusia.

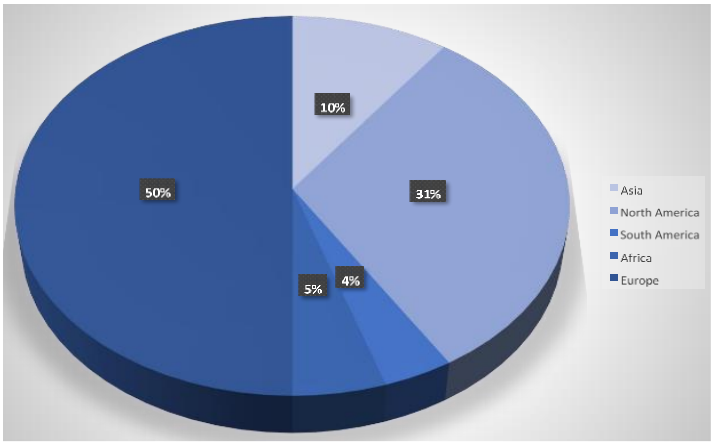

Figure 2: *Omicron case count in different continents.*

The common symptoms usually are a sudden onset of fever, coughing, and dyspnea. The more complicated symptoms include acute respiratory disorders, pneumonia, kidney damage, bacterial infections, coagulation abnormalities and thromboembolic events, sepsis, and even death. So far, some of the clinical factors, such as old age people, patient with diabetes, as well as come prevailing with some cardiovascular diseases, have been associated with outcome and t high risk of mortality [16] (Figure 2).

Statistics

From (Figure 3), it is concluded that the Delta variant is considered as the highly infectious and transmissible variant of COVID-19 followed by Alpha and Omicron.

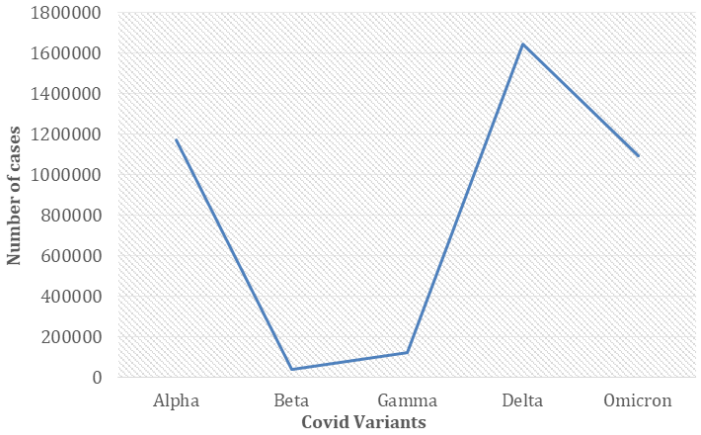

Figure 3: *Graphical representation of the number of case counts of different COVID-19 variants worldwide. (As of 9th February).*

Since, the Omicron cases is increasing day by day at an alarming rate and studies suggests that Omicron cases will elevate higher than delta counts.

Preventive Measures

The Preventive measures to control the Omicron Infection are

Monoclonal antibodies

A Monoclonal antibody is derived from the clone of single B-lymphocyte cell and fused with Myeloma cell through Hybridoma technology. Monoclonal Antibodies can be produced by two technique – 1) Recombinant Antibody production and 2) Hybridoma technology [17]. Due to rapidly increase in Omicron case count, the U.S. FDA (FOOD and DRUG ADMINISTRATION) uses the biotechnological method to treat the infection. The FDA revised the authorization for two Monoclonal Antibodies i.e., "Bamlanivimab" and "Etesevimab" and limit their use to only when person is infected with a variant. However, after studying and collecting data, it was suggested as these Monoclonal Antibodies are ineffective against Omicron variant which was circulating at an alarming rate in United States and hence the treatments are not authorized to use by FDA.

Booster doses

A Booster dose is an additional vaccine dose which is given after the two vaccine doses for protection and to fight against the infection. Booster dose helps in giving long-term protection

against infection caused by COVID-19 and other variants [18]. The Booster provides a noteworthy bump in protecting the infection without the third dose of vaccine [19]. The protection offer by vaccination is reduced mainly because if two reasons - The Antibodies which was generated by vaccination decreases over the time and Omicron can get away from vaccine induced immunity because of constellation of its mutations [20].

Vaccination

A vaccine is a suspension of weakened, killed or fragmented microbes or biological preparations or the toxins which is administered into the body to fight the infection caused by virus or antigens [21]. According to WHO (World Health Organization), Omicron variant is considered to be less severe but still it is a dangerous virus and hence vaccination is extremely important for protection and transmission of Omicron variant [22]. Since, the studies so far suggests that two vaccine doses may not be sufficient for protection against Omicron and hence boosting with an additional shot may be necessary which is Booster dose [23].

Self-Protective measures

Physical distancing, Wearing well fitted mask over nose and mouth, Work from home if possible.

Who recommended some actions for countries

There are several actions WHO recommends the countries to undertake and they are as follows- Enhancing surveillance and sequencing of cases. Sharing genome sequences on publicly available databases, like GISAID. Reporting of cases to WHO. Countries should enhance public health and medical capacities for the management of the cases.

The Actions Recommended For People by Who (World Health Organization)

The most common and best steps any person can take to prevent the expansion of infection is to maintain a physical distance from others (at least 1 meter). To wear a mask. Avoid the crowded places. To wash and sanitize the hands regularly. Cough or sneeze into a bent elbow. Most important is to get vaccinated.

Black fungus affecting covid patients

What is Blackfungus?

Blackfungus is a very rare type of fungal infection which is mostly caused by group of moulds called Mucormycetes present in soil, decayed fruits and organic matters, plants, manure and vegetables. It is also known as “Mucormycosis” [24,25]. Since, the black fungus is only be able to survive in the patients or individual with weak immune system especially who are suffering from diabetes mellitus (Hyperglycemia) or those taking immunosuppressive steroids to treat the COVID-19 infection. The COVID-19 was already a matter of great concern but the risk of fungal infection affiliated with it has increased the sense of havoc in India c.

Types of Mucormycosis: There are various types of Mucormycosis infection, they are –

- Cutaneous Mucormycosis (Skin).
- Rhinocerebral Mucormycosis (Sinus and Brain).
- Pulmonary Mucormycosis (Lungs).
- Gastrointestinal Mucormycosis.
- Disseminated Mucormycosis.

The second wave of COVID-19 affected lots of Indian with a very rare and mysterious fungal infection called as Mucormycosis. The studies concluded that the use of immunosuppressant for Covid-19 increases the chances of infection with blackfungus i.e. Mucormycosis [26]. Black fungus is a serious infection and if it is left Untreated at an early stage it may cause Blindness, Nerve damage, Blood clots, and may be a life threatening. According to the studies, it has a mortality rate of 50-54%. The patients who take the medicaments with a possibility to decrease the capacity of immune system to fight the infection are more susceptible to get infected with Black fungus. So, patients who are recovering from covid-19 have higher chances of black fungal infection. After studying, Doctors are suggesting that mucormycosis is being activated after the use of Steroids which is used for the treatment in severe and critically ill covid patient’s.

Black fungal infection (Mucormycosis) in Delta variant

In India, during the second wave of COVID-19, Mucormycosis was succeeded by an oxygen crisis and many of the patients suffered from prolonged hypoxia and ischemia throughout the recovery and many of the patients with minor black fungal infection symptoms were treated simply by isolating at home without oxygen. It is more probable that combination of prolonged hypoxia and severe hyperglycemia (diabetes mellitus) together may develops an ideal condition which may lead to faster black fungal infection [27].

Black fungus in Omicron variant

Since, we have seen a higher death rate in second wave due to Mucormycosis in covid patients. Now, the people are more concerned about the comeback of black fungus in Omicron variant i.e. in third wave. Doctors said that, there is no detection of black fungus counts in the Omicron cases because, most of the patients have mild to moderate symptoms and hence does not need immunomodulating agents and oxygen flow in the course of their treatment. However, mumbai city of India reported its first

case of black fungus in 2022 in a 70 year old patient diagnosed with covid symptoms.

Symptoms associated with Black fungal infection

Nasal congestion, Numbness, Swellings, Pain on the cheek bone, Uni-side facial pain, Blurred vision, Lesions on skin, Necrosis, chest pain, loosening of teeth, thrombosis, worsening of respiratory system [28,29].

Role of Nanomaterials or Nanoparticles in Omicron

Nanomaterials are considered as the materials whose size ranges from 1nm to 100nm i.e., less than 100nm. Nanomaterials can be obtained directly from nature or they may be obtained as the byproduct of the combustion reactions. The outbreak of newly designated variant of concern (Omicron) created a sense of havoc all over the world and the number of case counts are increasing at high rate and the mortality ratio is also increasing due to this infection. On this point, the Nanotechnology was the ray of hope for the development of novel approaches in treating, diagnosing, and preventing of Covid-19 and Omicron infection. Nanotechnology offers a nano-based materials for personal protection, diagnosis, treatment, for surface disinfectant, for production of vaccines, Covid-19 diagnostic kits, etc. Due to the distinctive properties of nanomaterials like nano size, faster solubility, surface adaptability and many other functions, they are now broadly used and studied for various purpose especially in medical field which results in the establishment of finer and safer drugs, personalized medicaments, and early detection and prevention of diseases [30]. Nanomaterials have been useful in developing face masks for protection against virus and in surface disinfectants with the self-disinfecting property has been exceedingly helpful for the hospitals and other health care systems. Here, previous studies have divulged that the Metals like Silver (Ag) and Copper (Cu) have the very good antiviral property. Ag-Cu combination nanomaterials shows an excellent biological function. Non-metals nanomaterials like hydrophobic graphene nanomaterials and Titanium dioxide (TiO2) have also been successfully developed by the scientist for face masks with self-disinfecting properties [31].

Role of Nanomaterials in Vaccine Production

Nanotechnology gripped large capability in vaccine production and also it could help to fight against the Covid infection by using various strategies like – manufacturing of infection free personal protectives to increase safety for health care system, designing of nano-based sensors for the detection of infection, manufacturing of new drugs, and importantly developing nano-based vaccines to enhance the immune system of the body. The vaccines made by using nanomaterials are considered as the very good substitute to the traditional vaccines because of controlled drug kinetics, highly stable nature, etc. The adjuvants derived from nano-based materials have more dominant properties which enhances the potency and efficacy of vaccines [32].

Role of Nanomaterials in Omicron Detection

Virus detection can be easily done by RT-PCR (Real Time Polymerase Chain Reaction) test, but the major disadvantage of that is the longer time for detecting the virus. Thus, Biosensors was one of the most beneficiary approaches for detecting the infection. For the identification of RNA-virus's nanomaterials like Gold (Au) – Silver (Ag) and surface plasmon resonance electrochemical Biosensors shows the promising role in helping as the portable instrument/tool for the diagnosis of Omicron infection [33].

Role of Nanomaterials in Gene Therapy

Nano-based materials are also helpful in gene therapy. Small interfering RNA's (SiRNA's) are highly effective in lowering the rate of replication in the virus. The safety and efficacy of SiRNA based gene therapy is dependent solely on targeted cellular or tissue delivery of interfering RNA's. In this point, nano-carriers which is innocuous, biocompatible i.e. Made up of lipids and polymers and also lipid/polymer hybrids nanomaterials, oxide of iron (Fe_2O_3), gold nano-based materials, nano-based hydrogels are used. These nano-carriers increases the stability of small interfering RNA's by stopping the degradation of enzymes [34].

Method of Preparation of Nanomaterials

Mainly there are 3 methods which is used to prepare nanomaterials *viz* –

Physical method: The physical method includes [35-39]

- High energy ball milling
- Laser pyrolysis
- Flash spray pyrolysis
- Inert gas condensation
- Electro spraying
- Melt mixing
- Pulse vapor deposition.

Biological Method: The biological methods for synthesizing nanomaterials are-

- Bio-templates assisted biogenesis
- Microorganisms assisted biogenesis
- Plant extracts assisted biogenesis.

Chemical Method:

- Sol-Gel synthesis
- Micro emulsion technique
- Hydrothermal synthesis

- Polyol synthesis
- Chemical vapor synthesis
- Plasma enhanced chemical vapor deposition.

Types of nanomaterials used in relation with Omicron

- Nano based lipid carriers.
- Hydrogels
- Polymeric nano-based capsules
- Graphene sheets
- Metal and non-metals nanoparticles
- Magnetic nanomaterials
- Carbon nano-based tube
- Hybrid nano composite
- Synthetic virus like particle
- Nano wires, rods, stars, etc.

Conclusion

After scientific study, the newly spread Omicron variant is considered to be highly transmissible, even among the vaccinated people. The Omicron variant reported firstly in South Africa on 24th of November and it has been spread extensively all over the world at higher rate. Omicron (B.1.1.529) variant has 32 spike mutations. Early studies indicates that the newly designated variant of COVID-19 is highly transmissible even among the vaccinated people. However, it can be controlled by taking various precautions and Booster dose along with vaccines. The spike protein of Omicron has several mutations which makes the virus more infectious. In USA, the death rates due to Omicron is increasing rapidly when compared to the death rates in the delta wave. One of the studies from Hong Kong University states that Omicron is able to duplicate 70 times faster in the bronchial tissues of human than any other variants of COVID-19. The extensive spread of Omicron variant has indicated that we need to remain on our guard. Some studies concluded that, Mucormycosis infection occurs mostly in unvaccinated individuals and people with vaccination have lower risk of getting infection. The review constate of the different types of the nonmaterial used for the production of omicron vaccine, the type of the nanomaterial.

Authors Contribution

All the authors have equally contributed in conceiving this research and designing of experiments; all authors have participated in the design and interpretation of the data; writing the paper and participated in the revisions of it. All authors read and approved the final manuscript.

Conflict of Interest

The authors Mohsina FP, Faheem IP, Patel Ilyas, and Khan Sabit declares that there is no conflict of interest.

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